SV730W

Multi-Axis Advanced Servo

EtherCAT Bus

User Manual

May 2026 V1.1

※ Preface

Thank you for choosing this product. This operation manual provides information related to the 730W series servo system—EtherCAT bus servo drives and motors. Please follow this manual to ensure correct operation. Improper use or handling may not only prevent the product from achieving its full performance but could also lead to accidents and reduce the product's service life.

Please read this instruction manual carefully and use the product correctly.

About the instruction manual

① While every effort has been made to ensure the accuracy of the contents in this instruction manual, any questions or concerns regarding the information should be directed to the company.

② The following items should be specified in the instruction manual for the machine incorporating this product.

- It is high-voltage electrical equipment and poses a hazard.
- Voltage remains on the terminals and inside the unit after power is turned off, posing a hazard.
- Localized high-temperature areas.
- Dismantling is strictly prohibited.

③ Product specifications and functions are subject to change or addition at any time without prior notice, due to reasons such as performance upgrades.

④ For equipment incorporating this product, if safety standard certification is planned, the company should be consulted in advance.

⑤ To extend the service life of the motor and drive, they should be used under correct operating conditions. Detailed usage must follow the instructions in this manual.

⑥ The instruction manual is updated to contain the latest information whenever possible; therefore, its contents are subject to frequent change. A new version of the instruction manual can be obtained by contacting the company.

⑦ Reproduction of part or all of the contents of this instruction manual is prohibited without the consent of the company.

Unboxing confirmation

- Whether the physical product matches your order.
- Whether there is any damage incurred during transportation.
- If any issues are found, please contact your distributor.

Read before use

Thank you for using the 730W series EtherCAT bus servo drive. This operation manual provides information for the 730W series EtherCAT bus servo drives and motors. Please be sure to refer to this manual when installing, operating, and maintaining the 730W series products. Incorrect operation or handling may not only prevent the product from achieving its full performance and reduce its service life, but may also lead to accidents.

Please keep this manual in a safe place for future reference.

Terminology

Terminology	Description
Servo motor	X2 series, X6 series servo motors
Servo drive	730W series EtherCAT bus servo drive

Servo system	A complete system composed of a servo drive, host device, and peripheral equipment.
Servo ON	Motor powered
Servo OFF	Motor not powered
Base block (BB)	A non-powered state formed by cutting off the base current of the power transistor in the current amplifier.
Servo lock	The state where the motor is stopped by a zero position command in the position loop.
Main circuit cable	Cable connected to the main circuit terminals (e.g., main circuit power cable, control power cable, servo motor power cable).

Target readers

This manual is intended for:

- Personnel with a basic understanding of electrical knowledge.
- Personnel responsible for the transportation and storage of the 730W series EtherCAT bus servo drives or related products.
- Personnel responsible for the installation, connection, commissioning, and maintenance of the 730W series EtherCAT bus servo drives or related products.

Products range

Certain specifications or limitations for the products covered in this manual may be described in other manuals. Details are listed in the table below:

This manual primarily provides information for the following products:
730W series EtherCAT bus servo drives

Manual revision notes

Version	Revision content
V1.0	First edition
V1.1	Revised naming rules and specification parameters; updated Chapter 5 Servo Basic Functions and Chapter 11 Parameter List; added notes and corrected some errors.

Other notes

- The content of this manual may be updated in accordance with hardware or software modifications made by Zhejiang Hechuan Technology Co., Ltd. Any changes to product specifications or related information will be posted on the HCFA official website: www.hcfa.cn, without prior notice.
- This manual has been compiled based on product information and customer requirements. If you have any questions or find any errors in the manual, please call HCFA or send an email to 400@hcfa.cn, and kindly provide the version number indicated on the cover for reference.
- Reproduction or copying of any part or the entirety of this manual is strictly prohibited.

Trademark notices

- EtherCAT® is a registered trademark of Beckhoff Automation GmbH and is an open-fieldbus network.
- Other products, product names, trademarks or registered trademarks mentioned in this manual are the property of their respective owners and are not products of our company.

※ Safety precautions

Safety precautions

Please always pay attention to the following safety precautions during acceptance, inspection, installation, wiring, operation, and maintenance.

◆ The safety instruction levels, which may be caused by the neglect of the instruction or incorrect use of this product, are classified and described in the following table.

DANGER ⚠	Indicates that incorrect handling may result in death or severe injury.
CAUTION ⚠	Indicates that incorrect handling may result in injury or property damage.

◆ The following graphical symbols are used to indicate items that must be observed.

🛇 Indicates what must not be done.

❗ Indicates what must be done.

DANGER ⚠

Installation and wiring

🛇	Do not connect the motor directly to a commercial power.	Otherwise, it may cause fire or malfunction.
	Do not place any combustibles near the servo motor and drive.	Otherwise, it may cause a fire.
❗	Please place the drive within a protective case, and leave specified clearances between the drive and control enclosure walls or other equipment.	Otherwise, it may cause an electric shock, fire, or malfunction.
	Please install the drive in a place that frees from excessive dust, water, and oil.	Otherwise, it may cause an electric shock, fire, malfunction, or damage.
	Please install the drive to incombustible, such as metal.	Otherwise, it may cause a fire.
	The wiring must be done by a professional electrician.	Otherwise, it may cause an electric shock.
	The FG terminal of the motor or the drive must be grounded.	Otherwise, it may cause an electric shock.
	Please cut off the upper circuit breaker before wiring.	Otherwise, it may cause an electric shock, injury, malfunction, or damage.
	Please ensure a good connection of the cable with its electrified part being well insulated.	Otherwise, it may cause an electric shock, fire, or malfunction.

Operation and running

	Do not touch the internal parts of the drive.	Otherwise, it may cause burns or an electric shock.
	The cables must not be excessively damaged, stressed, loaded, or pinched.	Otherwise, it may cause an electric shock or malfunction.
	Do not touch the rotating parts of the servo motor during operation.	Otherwise, it may cause injury.
	Do not use in wet areas, environments containing corrosive or flammable gases, or near combustible materials.	Otherwise, it may cause a fire.
	Do not use in locations subject to severe vibration or impact.	Otherwise, it may cause an electric shock, injury, or fire.
	Do not immerse the cables in oil or water during operation.	Otherwise, it may cause an electric shock, injury, or fire.
	Do not conduct wiring or perform operations with wet hands.	Otherwise, it may cause an electric shock, injury, or fire.
	Do not touch the keyway of the motor shaft with bare hands.	Otherwise, it may cause injury.
	Do not touch the motor, drive, and heat spreaders since they will heat up during operation.	Otherwise, it may cause burns or component damage.
	Do not connect the motor to an external power.	Otherwise, it may cause a fire.

Other safety precautions

	Please ensure equipment safety after earthquakes.	Otherwise, it may cause an electric shock, injury, or fire.
	Ensure a correct installation and setting to prevent fire or personal injury during earthquakes.	Otherwise, it may cause injury, electric shock, fire, malfunction, or damage.
	Please provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.	Otherwise, it may cause injury, electric shock, fire, malfunction, or damage.

Maintenance and inspection

	As there's dangerous and high-voltage inside the drive, before wiring or inspection, turn off the power and wait for 5 minutes or more until the charge indicator turns off. Do not disassemble the drive.	Otherwise, it may cause an electric shock.

CAUTION ⚠

Installation and wiring

	Please install the servo motor and drive following the combinations specified in this manual.	Otherwise, it may cause fire or malfunction.
	Do not touch the connector terminals directly.	Otherwise, it may cause an electric shock or malfunction.
	Do not block the intake and let any foreign materials enter into the equipment.	Otherwise, it may cause an electric shock or fire.
	The test operation must be done with the motor being fixed but separated from the mechanical system. Only after confirming the operation can the motor be installed to the mechanical system.	Otherwise, it may cause injury.
	The servo motor must be installed following the specified directions and methods.	Otherwise, it may cause injury and malfunction.
	Ensure a proper installation in accordance with the weight and rated output of the equipment.	Otherwise, it may cause injury and malfunction.

Operation and running		
⃠	Do not stand or put any heavy objects on the equipment.	Otherwise, it may cause an electric shock, injury, malfunction, or damage.
	Do not make extreme gain adjustments or changes, which will result in unstable running.	Otherwise, it may cause malfunction or damage.
	Keep it away from the direct sunlight.	Otherwise, it may cause malfunction.
	Do not subject the motor and its shaft to heavy impact.	Otherwise, it may cause malfunction.
	The electromagnetic brake on the motor is designed to hold its shaft and should not be used for normal braking.	Otherwise, it may cause injury and malfunction.
!	When power is restored after an instantaneous power outage, keep away from the machine because it may be restarted suddenly. Set the machine so that it is secured against personal injury if restarted.	Otherwise, it may cause injury.
	Do not use any malfunctioning or damaged motor or drive.	Otherwise, it may cause an electronic shock, fire, or injury.
	Please confirm that the power supply specification is normal.	Otherwise, it may cause malfunction.
	Holding brake is not a safety stopper used for ensuring machine safety. To ensure safety, install a stopper on the machine side.	Otherwise, it may cause injury.
	When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting the operation.	Otherwise, it may cause injury.
	The brake relay and the emergency stop relay must be connected in series.	Otherwise, it may cause injury or malfunction.
Transportation and storage		
⃠	Do not subject the equipment to rain, droplets, toxic gas, or fluid.	Otherwise, it may cause malfunction.
	Do not carry the motor by the cables or shaft during transportation.	Otherwise, it may cause injury and malfunction.
!	Do not drop or overturn the motor during transportation and installation.	Otherwise, it may cause injury and malfunction.
	For long-term storage, please contact HCFA via the contact information listed in this manual.	Otherwise, it may cause malfunction.
	Please store in a storage place that complies with the storage environment specified in this manual.	Otherwise, it may cause malfunction.
Other safety precautions		
!	Please insulate the battery with adhesive tape and dispose of it following the law of each country (area).	
	When disposing of the equipment, treat it as an industrial waste.	
Maintenance and inspection		
⃠	Please contact HCFA for further instructions on removal, installation, and repair.	Otherwise, it may cause malfunction.
	Do not turn on and off the main circuit power switch too frequently.	Otherwise, it may cause malfunction.
!	During operation or for a period after power is turned off, the motor, drive heat sink, and regenerative resistor may remain hot. Do not touch them.	Otherwise, burns or electric shock may occur.
	When the drive becomes faulty, switch off the control circuit and main power supply.	Otherwise, it may cause a fire.
	If the equipment is to be stored for a long time, please switch off the main power supply.	Otherwise, it may cause injury caused by the malfunction of the equipment.

Maintenance and inspection

< Warranty period>

● The term of warranty for the product is eighteen (18) months from the date of manufacture. However, for the motor with a brake, the warranty period does not exceed the maximum period that the shaft can accelerate or decelerate.

< Warranty coverage >

● This warranty applies only when the condition, method, environment, etc. of use comply with the terms and conditions and instructions that are stated in the manual. However, even during the warranty period, the repair cost will be charged to customers in the following cases.

① A failure caused by improper use, storage, handling, repair, or modification.

② A failure caused by drops after receipt or damages caused during transportation.

③ A failure caused by use beyond product specifications.

④ A failure caused by external factors such as fire, earthquake, thunder and lightning, flooding, wind hazard, salty damage, abnormal voltage fluctuation, and other unavoidable accidents.

⑤ A failure caused by the intrusion of water, oil, metal fragments, or other foreign materials.

● The warranty covers only the delivered product itself. HCFA is not liable for or compensates any consequential damages caused by product malfunctions.

Notation rules

Notation rules for negated signals

In this manual, negated signal names (signals active at low level) are indicated by adding a slash (/) before the signal name.

For example, "BK" is written as "/BK".

Notation rules for parameters

The notation rules differ between "Numeric value setting type" and "Function selection type".

Control modes applicable to this parameter:
Position: Position control
Speed: Speed control
Torque: Torque control

- **Numeric setting type**

Pn502	Rotation check value			Position Contro Torque	
	Setting range	Setting unit	Default value	Effective moment	Category
	1-10000	1rpm	20	Immediate effect	Basic setting

Pn502	Setting range	Setting unit	Default value	Effective moment	Category
Parameter number	Adjustable range of the parameter	The minimum setting unit (resolution) of the parameter value	Parameter value set at the factory	Effective moment after parameter number change	Parameter category

- **Function selection type**

Parameter		Meaning	Effective moment	Category
Pn002	n. □ 0 □□	Normal use of absolute encoder	After repowering	Basic setting
	n. □ 1 □□ Factory setting	Use absolute encoder as incremental encoder		
	n. □ 2 □□	Using the encoder as a single-turn absolute encoder (rotary)		

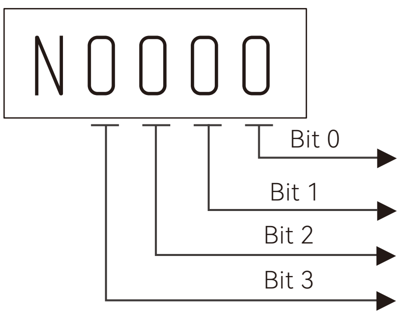
n. □□□□ indicates function selection type, □ represents the setting value of each bit; here, the 2nd bit is "1"

Function selection description

After parameter number change

Parameter category

- **Notation example (Example for Pn002.0)**



Bit notation		Setting value notation	
Notation method	**Meaning**	**Notation method**	**Meaning**
Pn002.0	Indicates bit 0 of the parameter	Pn002.0=X	Indicates bit 0 of the parameter is "x"
Pn002.1	Indicates bit 1 of the parameter	Pn002.1=X	Indicates bit 1 of the parameter is "x"
Pn002.2	Indicates bit 2 of the parameter	Pn002.2=X	Indicates bit 2 of the parameter is "x"
Pn002.3	Indicates bit 3 of the parameter	Pn002.3=X	Indicates bit 3 of the parameter is "x"

※ Contents

Chapter 3 EtherCAT Communication Introduction 70

Chapter 4 Commissioning and Operation 78

Chapter 5 Basic Function of Servo 82

Chapter 8 Auxiliary Functio 210

Chapter 9 Monitoring Display 228

Chapter 1 730W Overview

1.1 730w series product features

The HCFA 730W Series High-Performance Servo System is equipped with a new control algorithm platform that provides exceptional drive performance. It also includes a comprehensive suite of bus and expansion functions to meet the diverse control needs of customers across various industries. This system features seven core strengths: higher dynamic response, improved positioning accuracy, enhanced reliability, faster speeds, user-friendliness, and tuning-free functionality. These strengths collectively support customers in their industrial upgrades, ultimately enhancing the value and efficiency of machine tools. Let us join hands with you to redefine your machine’s performance.

For EtherCAT product applications, please refer to the 730W Series Servo System EtherCAT Bus Technical Manual.

1.2 730W nameplate information

Version information for the 730W series servo drives can be found on the label on the product side.

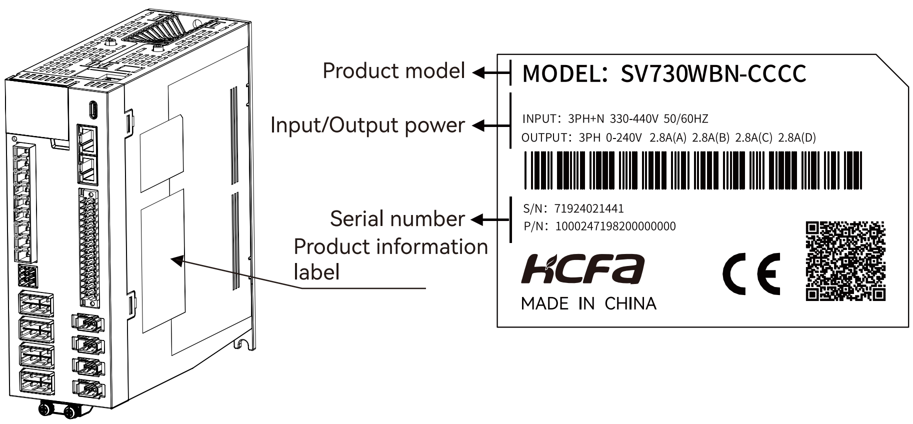


Figure 1-1 730W nameplate diagram

Table 1-1 Label description

Item	Function description
Product model	Displays the product model
Input/Output power	Displays the product’s input/output power INPUT: Current phase, rated input voltage/current/frequency OUTPUT: Current phase, output voltage range, maximum output current, maximum output power
Serial number	Displays the product’s serial number S/N: Internal serial number P/N: Internal serial number

1.3 730W drive naming rules

SV730 W B A - CCCC - 0000 - 000

Product series	
SV700	Series
SV730	
SV760	

Number of axes	
W	Multi-axis

Product type	
B	EtherCAT bus type

Voltage class	
A	AC220V 1P/3P
T	AC380V 3P
N	AC380V 3P+N

Current per axis	
A	0.9A
B	1.6A
C	2.8A
D	3.5A
E	4.7A
F	5.5A
G	7.6A
H	8.4A
K	11.6A
L	15.6A
M	17A
N	20A

Software/Hardware version

Custom code

1.4 730W servo drive component name

1.4.1 SIZE A AC220V (1P/3P) servo drive component diagram

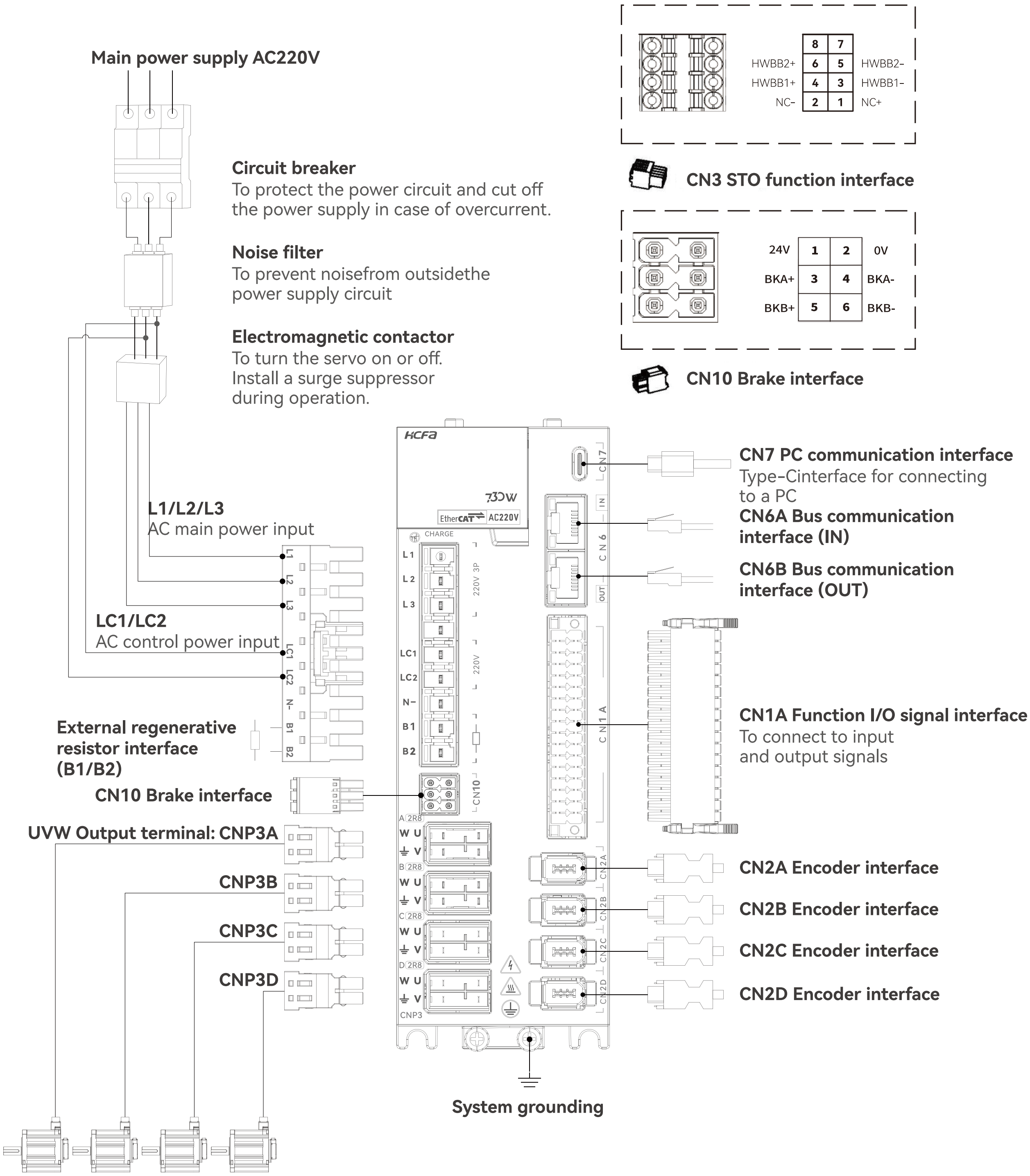


Figure 1-2 SIZE A AC220V(1P/3P) servo drive component diagram

1.4.2 SIZE A AC380V (3P+N) servo drive component diagram

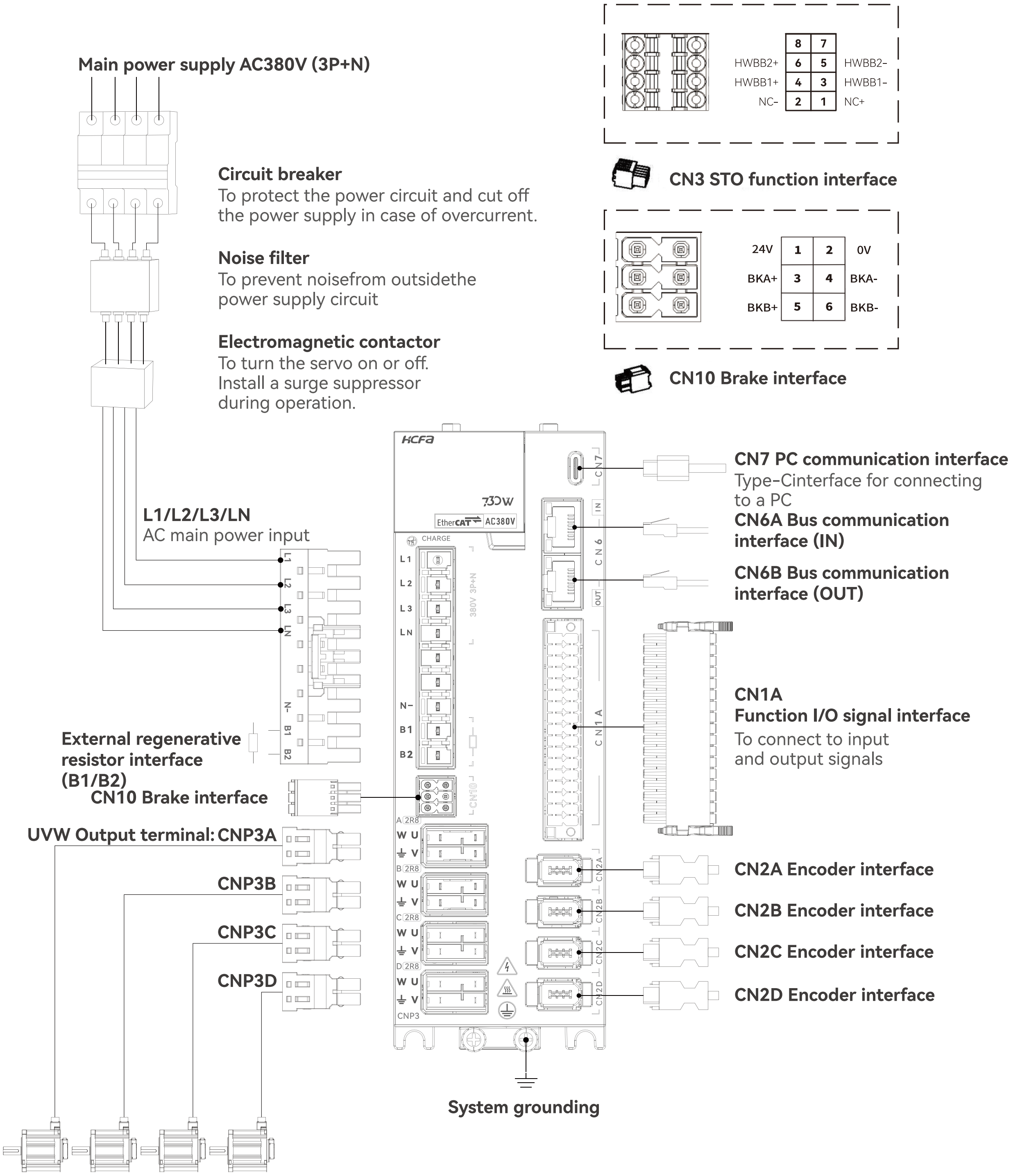


Figure 1-3 SIZE A AC380V(3P+N) servo drive component diagram

1.4.3 SIZE B AC220V (1P/3P) servo drive component diagram

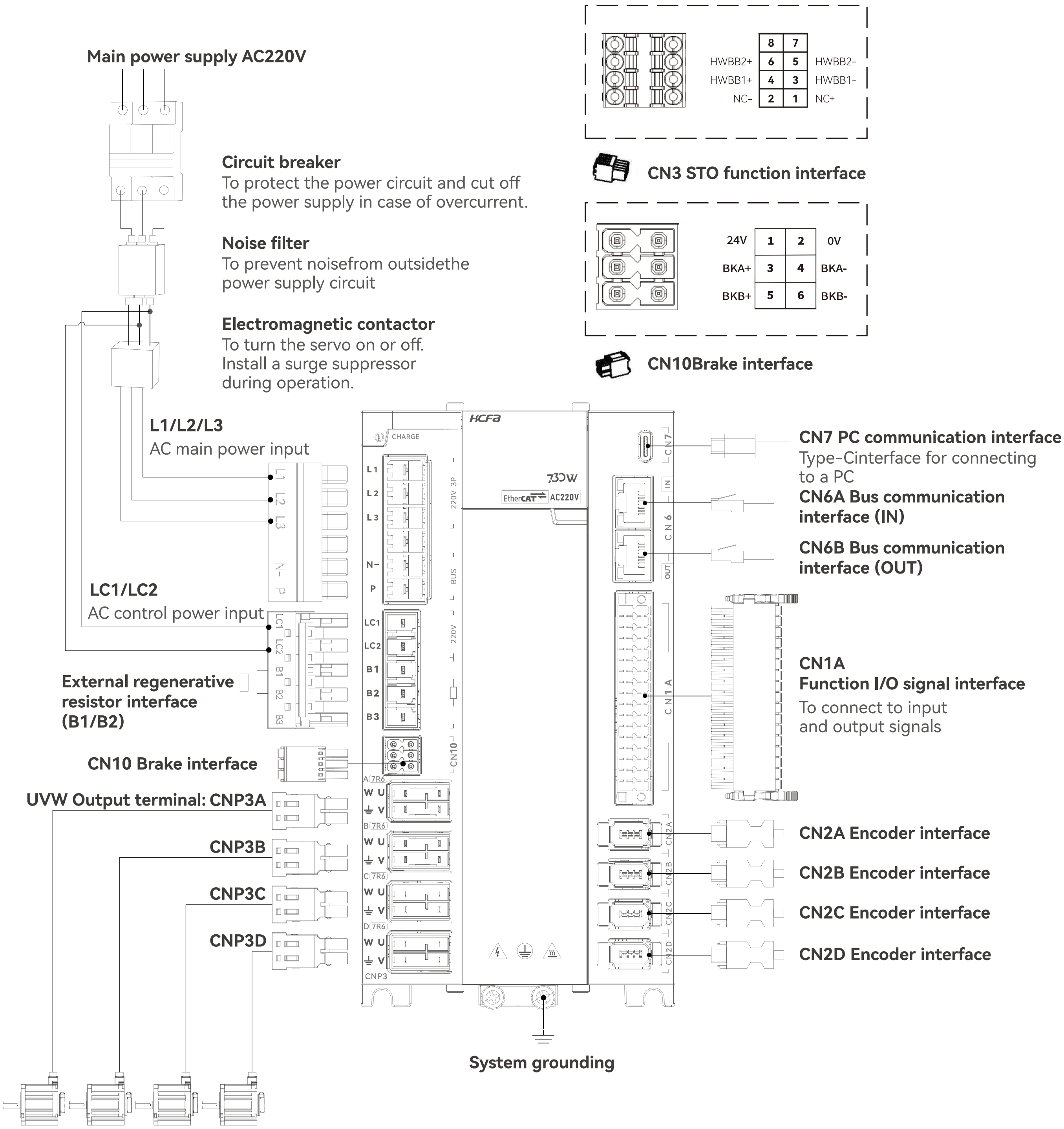


Figure 1-4 SIZE B AC220V(1P/3P) servo drive component diagram

1.4.4 SIZE B AC380V (3P+N) servo drive component diagram

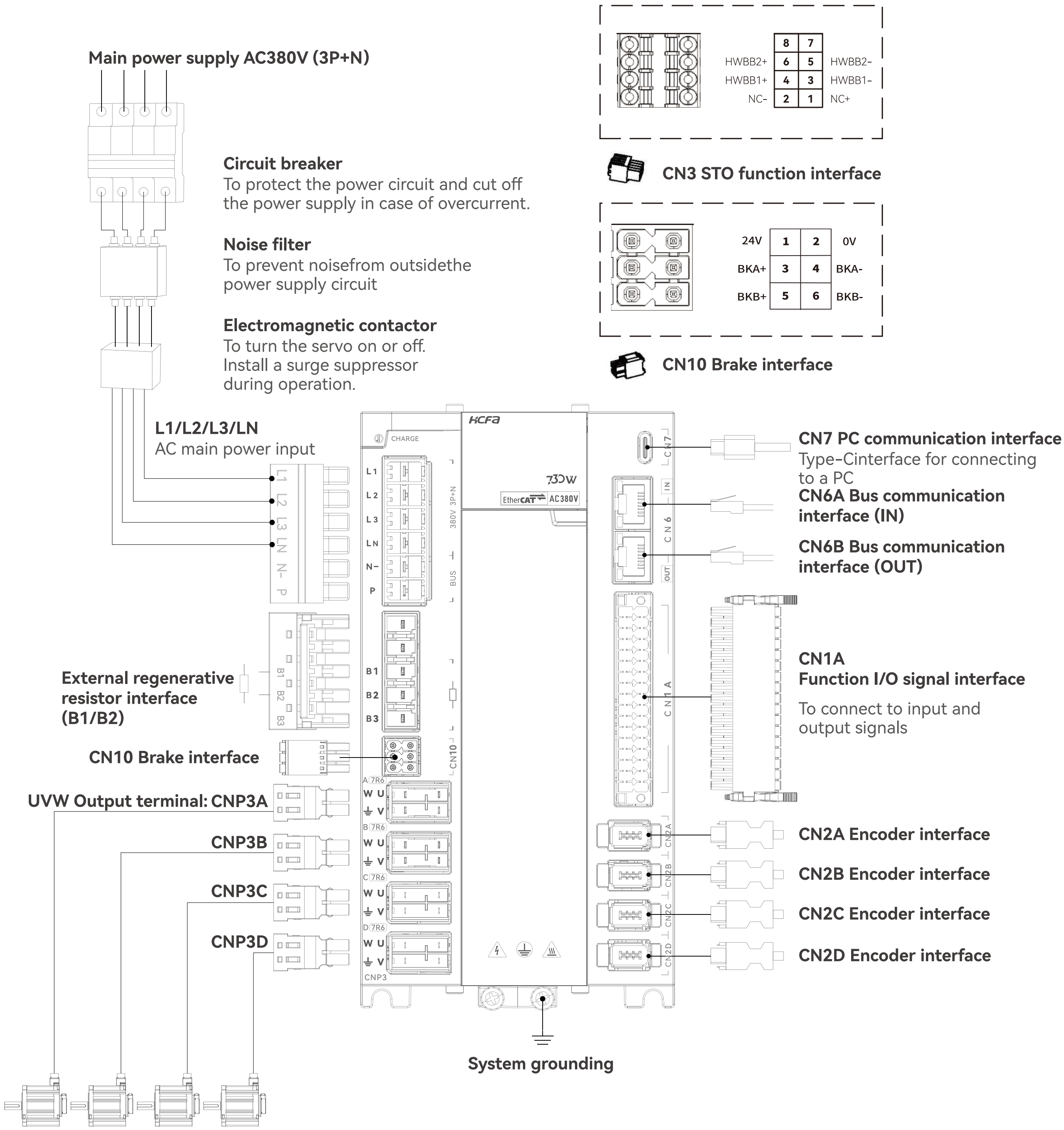


Figure 1-5 SIZE B AC380V(3P+N) servo drive component diagram

1.5 730W model specifications

1.5.1 Servo model specifications

Axis A		Axis B		Axis C		Axis D		Drive power supply	Control power supply	Communication method	Model
Power (kW)	Current (A)	Power (kW)	Current (A)	Power (kW)	Current (A)	Power (kW)	Current (A)				
0.4	2.8	0.4	2.8	0.4	2.8	0.4	2.8	AC220V 1P/3P	AC220V	EtherCAT	SV730WBA-CCCC
0.4	2.8	0.4	2.8	0.4	2.8	0.4	2.8	AC380V 3P+N	Common main circuit power supply	EtherCAT	SV730WBN-CCCC
1	7.6	1	7.6	1	7.6	1	7.6	AC220V 1P/3P	AC220V	EtherCAT	SV730WBA-GGGG
1	7.6	1	7.6	1	7.6	1	7.6	AC380V 3P+N	Common main circuit power supply	EtherCAT	SV730WBN-GGGG

1.6 730W servo drive ratings & specifications

The servo drive's ratings and specifications are shown below.

1.6.1 AC220V (1P/3P) basic specifications

Item			Specification	
SV730W*A-****			C	G
Maximum applicable motor capacity (kW)			1.6	4
Number of axes			4	4
Single-axis power (kW)			0.4	1
Single-axis continuous output current (Arms)			2.8	7.6
Single-axis instantaneous maximum output current (Arms)			9.3	17
Main circuit	Power supply voltage (Vrms)		Single-phase/Three-phase AC200 ~ 240V, 50/60Hz	
	Current (Arms)		7.6	19.2
Control power supply			Single-phase AC200 ~ 240V, 50/60Hz	
Power loss	Main circuit power loss (W)		80	195
	Control circuit power loss (W)		15	17
	Built-in regenerative resistor power loss (W)		—	—
	Total power loss (W)		95	212
Regenerative resistor	Built-in resistor	Resistance value (Ω)	—	—
		Capacity (W)	—	—
	Minimum allowable external resistance value (Ω)		12	12
Overvoltage category			III	

1.6.2 AC380V (3P+N) basic specifications

<table>
<tr><th colspan="3">Item</th><th colspan="2">Specification</th></tr>
<tr><td colspan="3">SV730W*N-****</td><td>C</td><td>G</td></tr>
<tr><td colspan="3">Maximum applicable motor capacity (kW)</td><td>1.6</td><td>4</td></tr>
<tr><td colspan="3">Number of axes</td><td>4</td><td>4</td></tr>
<tr><td colspan="3">Single-axis power (kW)</td><td>0.4</td><td>1</td></tr>
<tr><td colspan="3">Single-axis continuous output current (Arms)</td><td>2.8</td><td>7.6</td></tr>
<tr><td colspan="3">Single-axis instantaneous maximum output current (Arms)</td><td>9.3</td><td>17</td></tr>
<tr><td rowspan="2">Main circuit</td><td colspan="2">Power supply voltage (Vrms)</td><td colspan="2">Three-phase, four-wire AC 330-440V, 50/60Hz</td></tr>
<tr><td colspan="2">Current (Arms)</td><td>9.3</td><td>21.9</td></tr>
<tr><td colspan="3">Control power supply</td><td colspan="2">Common DC busbar</td></tr>
<tr><td rowspan="4">Power loss</td><td colspan="2">Main circuit power loss (W)</td><td>80</td><td>195</td></tr>
<tr><td colspan="2">Control circuit power loss (W)</td><td>15</td><td>17</td></tr>
<tr><td colspan="2">Built-in regenerative resistor power loss (W)</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">Total power loss (W)</td><td>95</td><td>212</td></tr>
<tr><td rowspan="3">Regenerative resistor</td><td rowspan="2">Built-in resistor</td><td>Resistance value (Ω)</td><td>—</td><td>—</td></tr>
<tr><td>Capacity (W)</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">Minimum allowable external resistance value (Ω)</td><td>12</td><td>12</td></tr>
<tr><td colspan="3">Overvoltage category</td><td colspan="2">III</td></tr>
</table>

1.6.3 Environmental specifications

<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Ambient temperature</td><td>0 ~ +55℃ (for temperature above 45℃ , derate by 10% for every 5 degrees increase in ambient temperature)</td></tr>
<tr><td>Storage temperature</td><td>-20 to 85° C (Maximum rated temperature: 80° C for 72 hours, non-condensing)</td></tr>
<tr><td>Ambient humidity</td><td>20% to 85% RH, non-condensing</td></tr>
<tr><td>Storage humidity</td><td>20% to 85% RH, non-condensing</td></tr>
<tr><td>Vibration</td><td>5.88 m/s^2 (0.6G) max., 10-60Hz (avoid operation at resonant points)</td></tr>
<tr><td>Shock resistance</td><td>Acceleration: 19.8 m/s^2 max. (X, Y, Z axes)</td></tr>
<tr><td>Protection class</td><td>IP20</td></tr>
<tr><td rowspan="2">Cleanliness</td><td>• Free from corrosive and flammable gases</td></tr>
<tr><td>• Free from splashing water, oil, or chemicals</td></tr>
<tr><td>Altitude</td><td><1000m (for altitudes between 1000m and 2000m, use with derated specifications)</td></tr>
<tr><td>Pollution degree (PD)</td><td>2</td></tr>
<tr><td>Overvoltage category</td><td>III</td></tr>
<tr><td>Fault short-circuit current</td><td>5Ka</td></tr>
<tr><td>Other</td><td>No electrostatic interference, strong electric field, strong magnetic field, radiation, etc.</td></tr>
</table>

1.6.4 Technical specifications

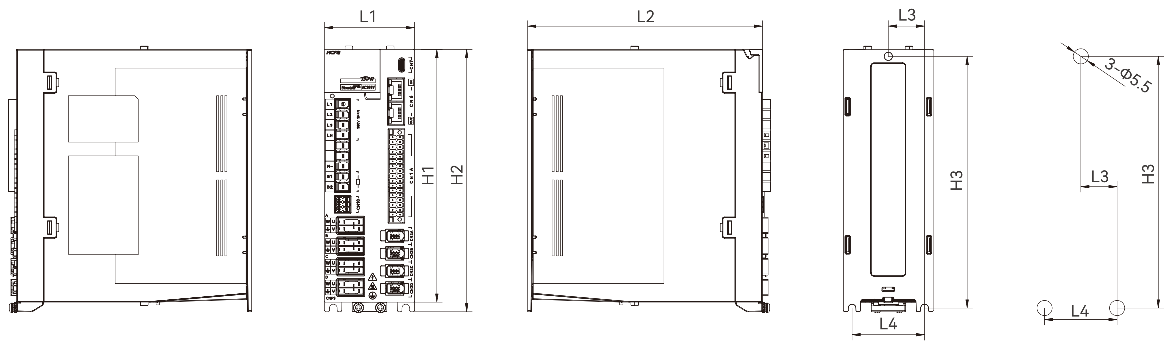
Item				Specification
Speed/ Torque control mode	Performance	Speed variation rate	Load variation rate	0~100% load: ≤ 0.5% (at rated speed)
			Voltage variation rate	Rated voltage ±10%: 0.5% (at rated speed)
			Temperature variation rate	25±25℃ : ≤ 0.5% (at rated speed)
		Speed control range		1:10000 (lower limit: motor does not stop under rated torque load)
		Torque control accuracy		±1%
	Input signal	Speed command input	EtherCAT communication mode	CSV/PV mode
		Torque command input	EtherCAT communication mode	CST/PT mode
Position control mode	Performance	Feedforward compensation		0~100.0% (setting resolution: 0.1%)
		Timing window		1~65535 encoder units
	Input signal	EtherCAT communication mode		CSP mode/PP mode/HM mode
Input/ Output signal	Sequential control input signal	Input signal function selection		21-channel DI DI1~DI21: General-purpose DI (100µs input delay on rising edge (signal transition from high to low at 24V input); 50µs input delay on falling edge (signal transition from low to high at 24V input); voltage: 21.6V~26.4V)
				DI functions are as follows: positive overtravel switch (POT), negative overtravel switch (NOT), home switch (DEC), probe 0 (LATCH_0), probe 1 (LATCH_1), emergency stop (FSTP), positive torque limit (P_CL), negative torque limit (N_CL), servo enable (S-ON), alarm reset signal (ALMCLR), power down signal (PWR-DOWN), user-defined signals 1~7 (USER1~7)
	Sequential control output signal	Output signal function selection		8-channel DO DO load capacity: 50mA; voltage range: 5V~30V
				DO functions are as follows: positioning complete (COIN), speed coincidence (V_CMP), motor running (TGON), servo ready (S_RDY), torque limit (CLT), velocity limit (VLT), brake (BK), warning (WARN), position proximity (NEAR), position comparison outputs 1~4 (POSCMP1~4), alarm signal (ALM), userdefined signals 1~7 (USER1~7)
Built-in function	Overtravel (OT) limit function			Immediate stop when P-OT/N-OT actuates.
	Electronic gear ratio			0.001 ≤ B/A ≤ Encoder resolution*0.4
	Protection function			Overcurrent, overvoltage, undervoltage, overload, main circuit detection anomaly, heatsink overheating, power phase loss, overspeed, encoder anomaly, CPU anomaly, parameter anomaly, others
	Safety function	Safety function type		STO
		Applicable standard		IEC 61800-5-2:2016
	LED display function			Main power CHARGE status displayed on 6-digit LED
	Vibration suppression function			5 notch filters (50Hz ~ 5000Hz), including 2 adaptive ones
	Ease-of-use function			One-touch parameter adjustment, adaptive parameter adjustment, speed observer, model tracking
	Communication function	Background debugging		Type_C
		Multi-station communication protocol		EtherCAT
		Number of axes for multi-station communication		Maximum number of slave stations: 65535
		Axis address setting		No physical knobs; configured via software (0 ~ 65535)
		Function		Status display, user parameter setting, monitoring display, alarm tracing display, JOG operation, auto-tuning, communication & motion control command input
		Other		Gain adjustment, alarm recording, JOG operation

1.7 730W servo drive outline dimensions

1.7.1 730W drive configuration table

Servo drive	SIZE WA	SIZE WB
AC220V 1P/3P	SV730WBA-CCCC	SV730WBA-GGGG
AC380V 3P+N	SV730WBN-CCCC	SV730WBN-GGGG

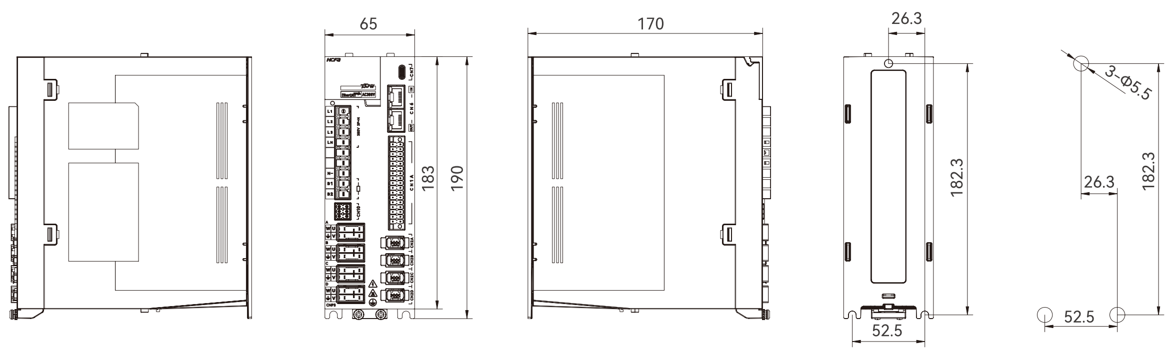
1.7.2 730W series drive installation dimensions



Left view Front view Right view Rear view Hole position diagram

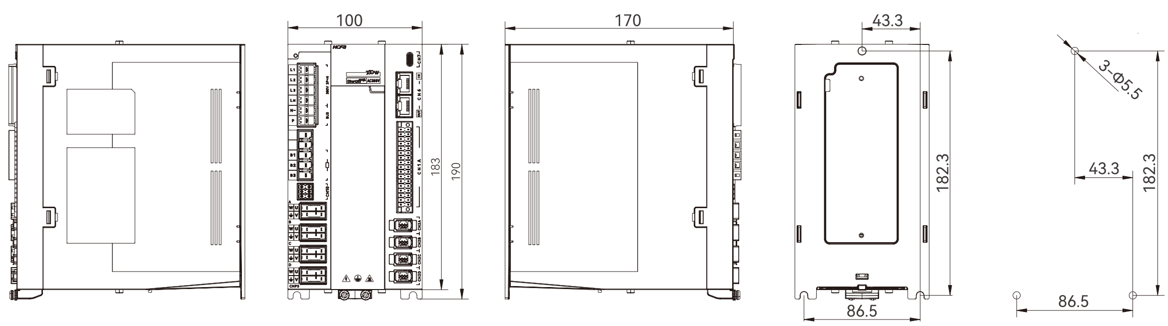
Size	L1(mm)	L2(mm)	L3(mm)	L4(mm)	H1(mm)	H2(mm)	H3(mm)	Hole diameter (ϕ)	Screw hole	Locking torque (Nm)	Weight (kg)
SIZE WA	65	170	26.3	52.5	183	190	182.3	5.5	3-M5	3.5N·M	0.76
SIZE WB	100	170	43.3	86.5	183	190	182.3	5.5	3-M5	3.5N·M	1.01

1.7.3 SIZE WA drive outline dimensions



Left view Front view Right view Rear view Hole position diagram

1.7.4 SIZE WB drive outline dimensions



Left view Front view Right view Rear view Hole position diagram

1.8 Drive installation

1.8.1 Installation within a control cabinet

Precautions

- Do not block the servo drive's air inlets/outlets or place it upside down; otherwise, malfunctions may occur.
- To ensure the cooling fans have low air resistance for effective heat dissipation, follow the recommended installation spacing when installing one or more drives.
- Avoid vertical stacking, as the heat generated by the lower drive during operation rises, which can cause an unnecessary temperature increase in the upper drive.

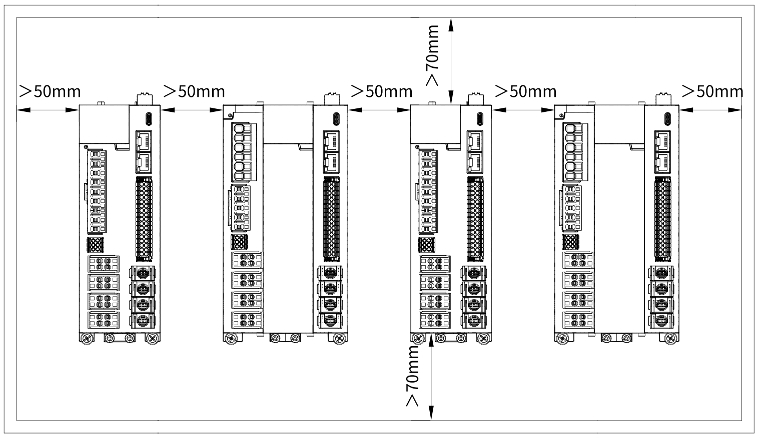


Figure 1-6 Schematic diagram of 730w servo drive installation within a control cabinet

1.8.2 Mechanical Installation Instructions

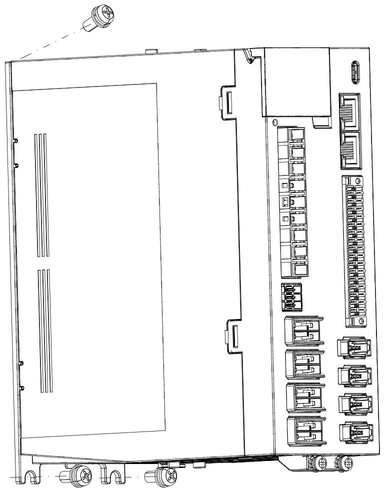


Figure 1-7 730W servo unit mechanical installation diagram

Note: Use M5 * 20 screws to mount the drive to the cabinet backplate. Tightening torque: 3.5 Nm.

1.9 Maintenance and inspection

The following describes the maintenance and inspection of servo drives.

Inspection of servo motors

Servo drives do not require daily inspections, but the following items must be inspected at least once a year.

Inspection item	Inspection interval	Inspection key point	Troubleshooting
Appearance inspection	At least once a year	No garbage, dust, oil stains, etc.	Wipe with a cloth or blow with an air gun
Screw looseness check		No looseness in terminal block, connector mounting screws, etc.	Tighten screws further

Chapter 2 Wiring and Connection

2.1 Precautions

2.1.1 Symbols

Table 2-1 Precaution Symbols

Name	Function
DANGER ⚠	Indicates hazards that may cause death or serious injury
CAUTION ⚠	Indicates precautions that may cause injury or property damage
❗	Indicates the mandatory content that must be implemented

2.1.2 General wiring precautions

Points

Please use a circuit breaker or fuse for wiring to protect the main circuit.

・The servo unit is directly connected to the industrial frequency power supply without using a transformer for insulation. In order to prevent accidents of mixed contact between the servo system and the outside, be sure to use a circuit breaker or fuse for wiring.

・Please install an earth leakage circuit breaker. The servo unit does not have a built-in ground short-circuit protection circuit. In order to build a safer system, install an earth leakage circuit breaker for both overload and short circuit protection, or combine it with a circuit breaker for wiring and install an earth leakage circuit breaker for ground short circuit protection.

・Please avoid turning ON/OFF power frequently

・Frequently turn ON/OFF power will cause elements in servo drive to deteriorate, so do not use it for applications that require to turn ON/OFF power frequently.

・After you have started actual operation(normal operation), allow at least one hour between turning the power supply ON and OFF.

To ensure safe, stable application of the servo system, please observe the following precautions when wiring.

I. Use the cables specified by HCFA. Design and arrange the system so that each cable is as short as possible.

・Use twisted-pair wires or multi-core twisted-pair shielded wires for I/O signal cables and encoder cables.

・The wiring length of the input and output signal cables is up to 3m, and the length of the main circuit cable of the servo motor and the encoder cable is up to 10m each.

II. Observe the following precautions when wiring the ground cable.

・Use a ground cable as thick as possible(2.0 mm2 or more).

・Please ground 220V servo unit to a resistance of 100Ω or less, and ground 380V servo unit with a resistance of 10Ω or less.

・Be sure to ground at one point only.

・Ground the servo motor directly if the servo motor is insulated from the machine.

III. The signal cable conductors are as thin as 0.2 mm or 0.3 mm. Do not subject them to excessive bending stress or tension.

Wiring points:

※ The control circuit power supply and the main circuit power supply should be wired from the same AC220V main power supply.

※ When the user I/O cable is longer than 50cm, please use twisted pair with shielded wire.

※ Encoder cable length is 20m or less.

Note: 1. There is high voltage in the circuit in the solid line. Be careful when wiring and handling.

2. The dotted part of the wiring diagram indicates a non-hazardous voltage circuit.

This section also explains the general precautions when wiring and the precautions in special use environments.

Table 2-2 Precautions for Special Use Environment

Item	Description
External machine configuration	In order to comply with European EC standards, after selecting a machine with applicable specifications, please set it according to the system diagram.
Environment	The driver is installed in an environment of pollution degree 2 or pollution degree 1 specified in IEC60664-1.
Power supply 1 : AC200 ~ 240V main circuit and control circuit power supply)	This product is used in an overvoltage category II power supply environment in accordance with IEC60664-1.
Power supply 2: DC24V ・ I/O power ・Release the power supply of the motor brake	The DC24V external power supply must meet the following conditions: Use SELV power supply (※), the capacity is below 150W (this is the condition when corresponding to European CE); Safe low voltage/non-hazardous voltage, hazardous voltage require reinforced insulation (Attention).
Wiring	Motor power cables, AC220V input cables, FG cables, and main circuit power distribution cables composed of multiple axes: Please use AWG18 / 600V withstand voltage wires below 750W , and use AWG14 / 600V withstand voltage wires above 1kW .
Leakage circuit breakers	To protect the power line, the circuit is cut off when an overcurrent flows. Between the power supply and the noise filter, be sure to use an IEC standard and UL- approved circuit breaker. To comply with EMC standards, please use a standard circuit brake with leakage detection function.
Noise filter	Prevent noise interference from power lines (Use standard noise filtering for EMC compliance).
Electromagnetic contactor	Switch (ON/OFF) the main power supply (please use it with a surge protector connected).
Surge absorber	To comply with EMC regulations, please use standard surge absorbers.
Signal Line Noise Filter / Ferrite Core	To comply with EMC standards, please use standard noise filters.
Regenerative resistor	If the smoothing capacitor inside the power unit cannot sufficiently absorb and process regenerative power, it is necessary to install a regenerative resistor outside. For reference, check the setting panel for regenerative discharge status, and use a regenerative resistor when regenerative voltage warning occurs. Regenerative resistor reference specification: Please refer to external braking resistor selection. Use the built-in thermostat, and set the overheat protection circuit.
Grounding	Our products have protection settings because they are suitable for Class 1 equipment. The grounding of our products requires protective ground terminal, and is carried out through a protective box and an electrical box that have implemented EMC countermeasures. The protective ground terminal is indicated by the standard FG mark.

Note: ※SELV: safety extra low voltage.

2.2 SIZE A AC220V (1P/3P) drive terminal definition diagram

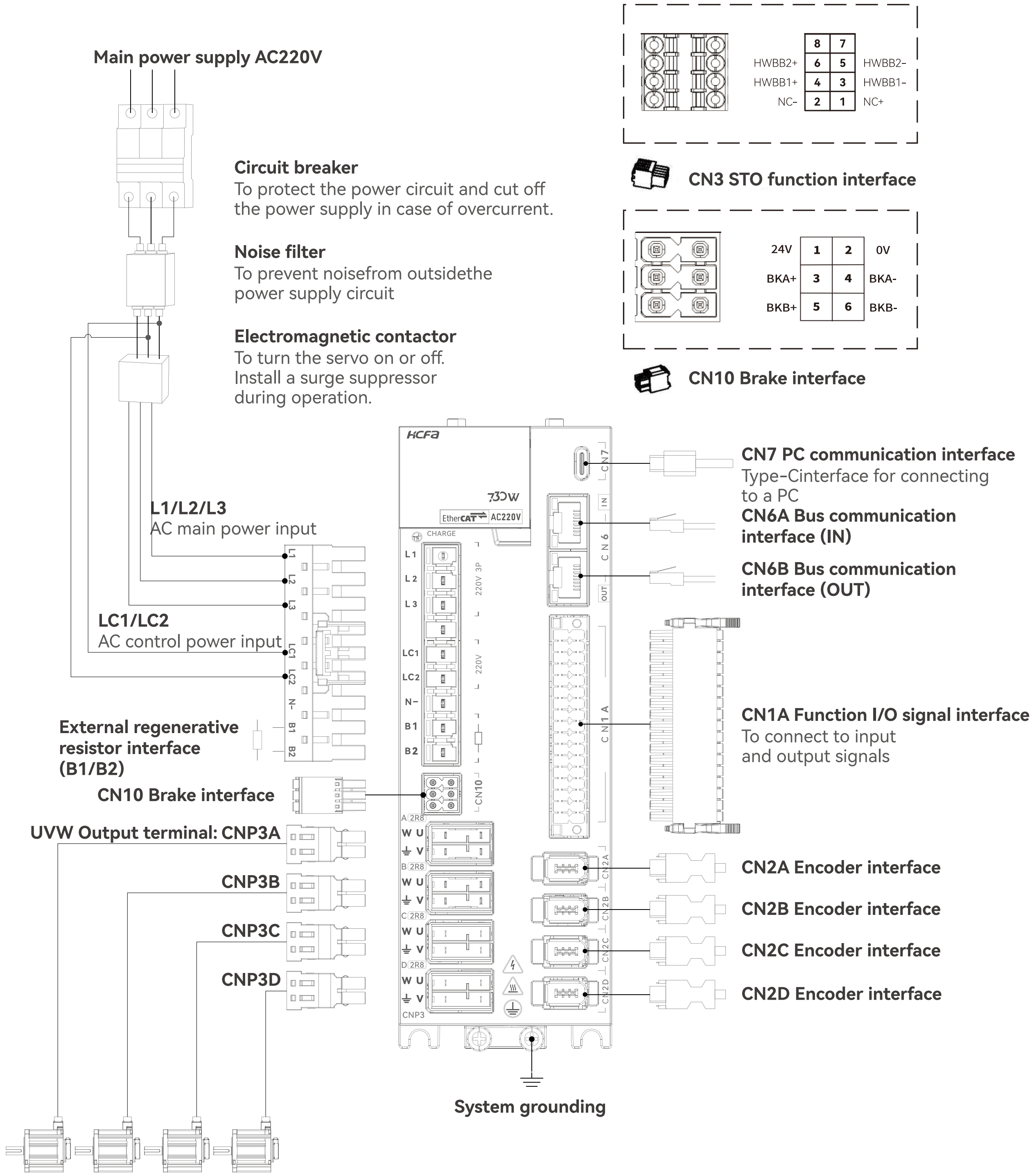


Figure 2-1 SIZE A AC220V (1P/3P) Drive Terminal Wiring Diagram

Table 2-3 Terminal Symbols and Terminal Names for SIZE A AC220V (1P/3P)

Terminal name	Terminal symbols	Signal name/ pin number	Content
Regenerative resistor	B1/B2	B1	External regenerative resistor interface , main circuit bus+
		B2	External regenerative resistor interface
Main circuit bus	N-	N-	Main circuit bus-
AC main circuit power input	L1/L2/L3	L1	AC220V(1P/3P) model: AC200~240V (50/60Hz) Note: Please confirm the drive power specification when wiring
		L2	
		L3	
AC control power input	LC1/ LC2	LC1	AC220V(1P) model: AC200~240V (50/60Hz) Note: Please confirm the drive power specification when wiring
		LC2	
Motor power output	U/V/W	U	Motor power U phase output
		V	Motor power V-phase output
		W	Motor power W phase output
Encoder	CN2	1	Encoder power supply 5V output
		2	Signal Ground
		3	—
		4	—
		5	Encoder signal: serial data+
		6	Encoder signal: serial data-
		Shell	The shield wire is connected to the connector shell
Communication	CN6A/CN6B	-	EtherCAT communication interface
User I/O	CN1	Refer to 2.6 Input and output signal (CN1) wiring details	
Brake	CN10	1	Brake + 24V power supply
		2	Brake 0V
		3	BKA+
		4	BKA-
		5	BKB+
		6	BKB-
Ground terminal	⏚	Connect to the ground terminal of the power supply and the servo motor for grounding.	

Note: Do not short-circuit B1/B2, the servo unit may be damaged.

2.3 SIZE A AC380V (3P+N) drive terminal definition diagram

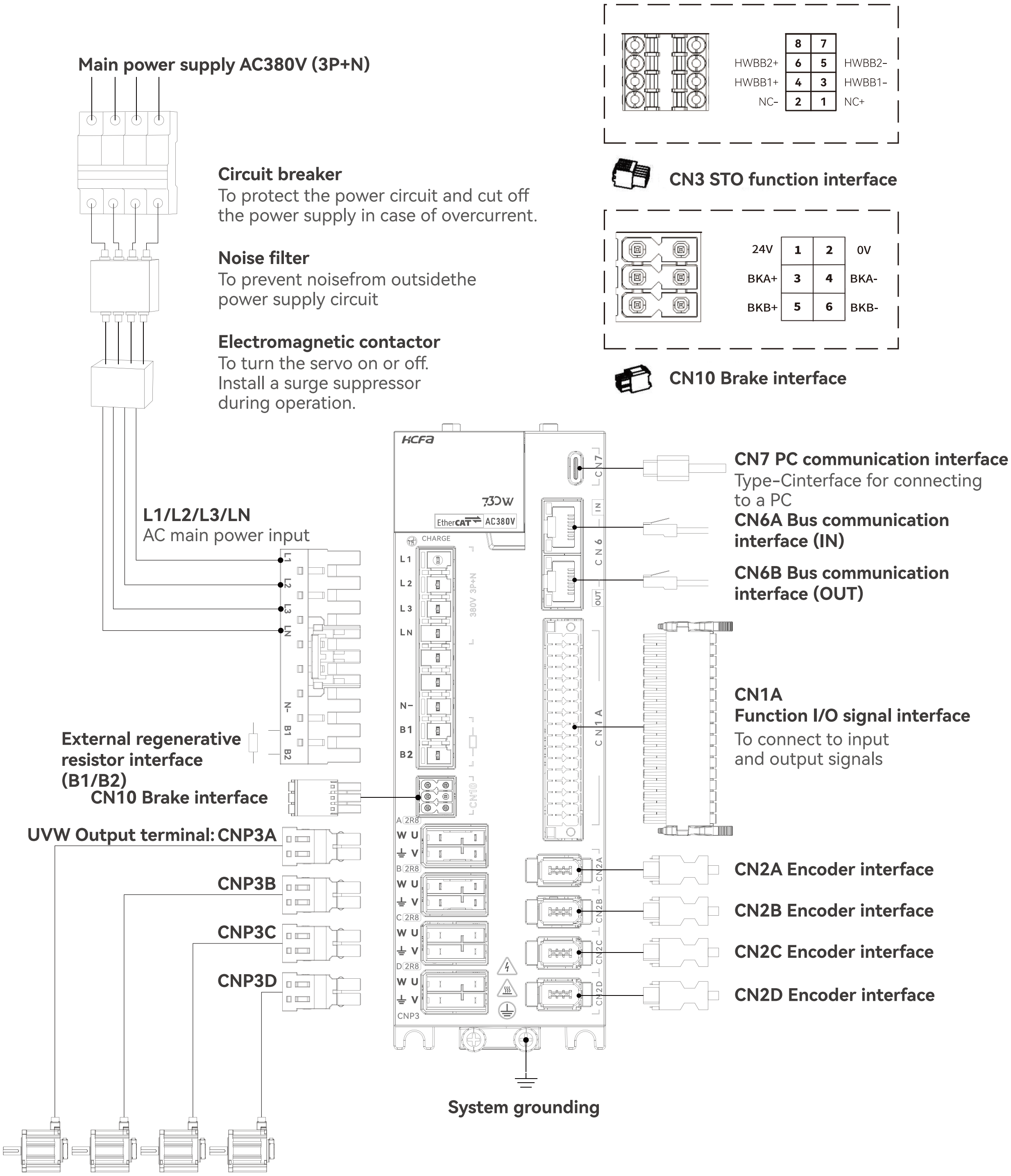


Figure 2-2 SIZE A AC380V (3P+N) Drive Terminal Wiring Diagram

Table 2-4 Terminal Symbols and Terminal Names for SIZE A AC380V (3P+N)

Terminal name	Terminal symbols	Signal name/ pin number	Content
Regenerative resistor	B1/B2	B1	External regenerative resistor interface , main circuit bus+
		B2	External regenerative resistor interface
Main circuit bus	N-	N-	Main circuit bus-
AC main circuit power input	L1/L2/L3/LN	L1	AC380V(3P+N) model: AC330~440V (50/60Hz) Note: Please confirm the drive power specification when wiring
		L2	
		L3	
		LN	
Motor power output	U/V/W	U	Motor power U phase output
		V	Motor power V-phase output
		W	Motor power W phase output
Encoder	CN2	1	Encoder power supply 5V output
		2	Signal Ground
		3	—
		4	—
		5	Encoder signal: serial data+
		6	Encoder signal: serial data-
		Shell	The shield wire is connected to the connector shell
Communication	CN6A/CN6B	-	EtherCAT communication interface
User I/O	CN1	Refer to 2.6 Input and output signal (CN1) wiring details	
Brake	CN10	1	Brake + 24V power supply
		2	Brake 0V
		3	BKA+
		4	BKA-
		5	BKB+
		6	BKB-
Ground terminal	⏚	Connect to the ground terminal of the power supply and the servo motor for grounding.	

Note: Do not short-circuit B1/B2, the servo unit may be damaged.

2.4 SIZE B AC220V (1P/3P) drive terminal definition diagram

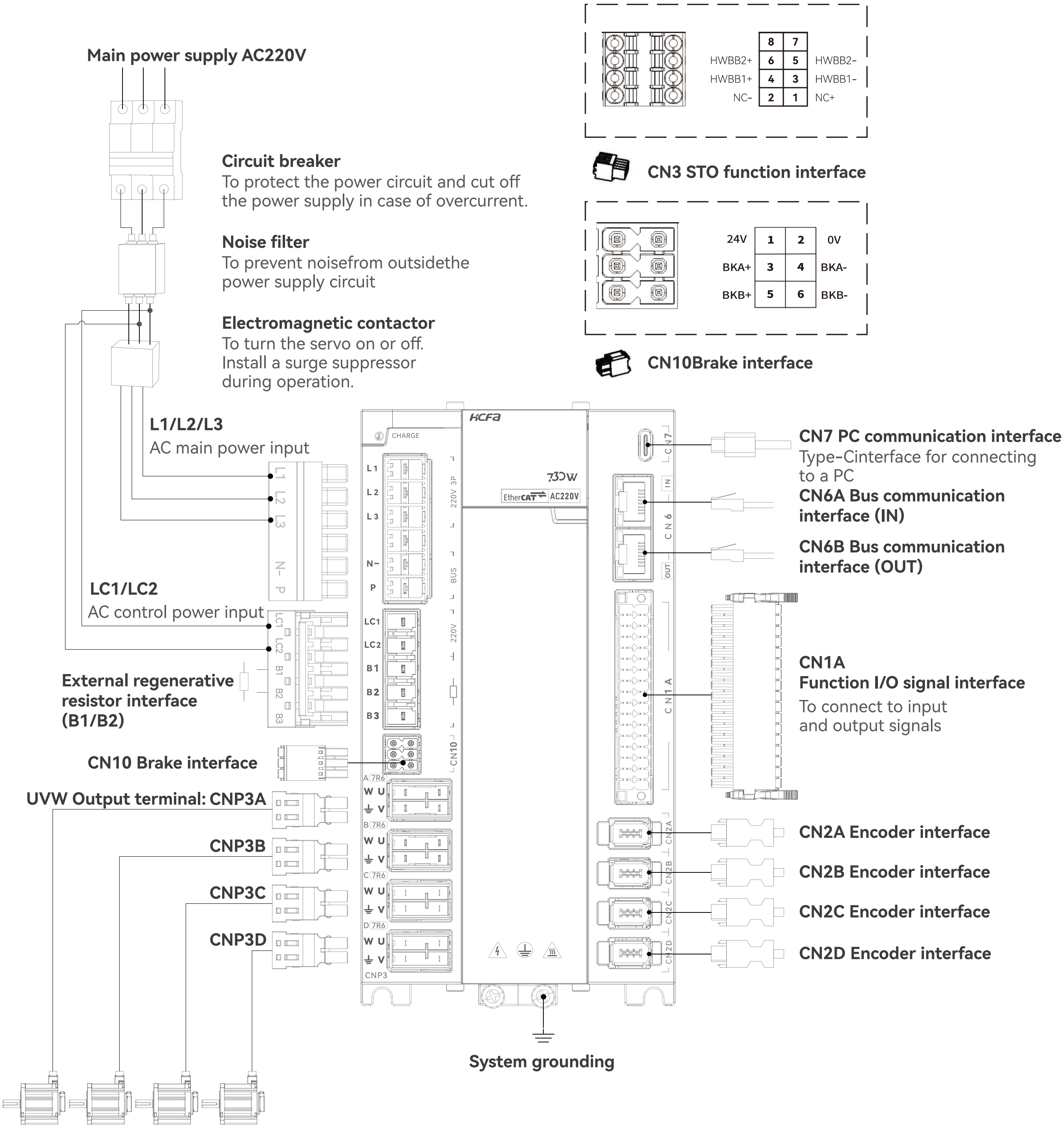


Figure 2-3 SIZE B AC220V (1P/3P) Drive Terminal Wiring Diagram

Table 2-5 Terminal Symbols and Terminal Names for SIZE B AC220V (1P/3P)

Terminal name	Terminal symbols	Signal name/ pin number	Content
Regenerative resistor	B1/B2/B3	B1	External regenerative resistor interface , main circuit bus+
		B2	External regenerative resistor interface
		B3	Built-in regenerative resistor interface
Main circuit bus	N-/P	N-	Main circuit bus -
		P	Main circuit bus+
AC main circuit power input	L1/L2/L3	L1	AC220V(1P/3P) model: AC200~240V (50/60Hz) Note: Please confirm the drive power specification when wiring
		L2	
		L3	
AC control power input	LC1/ LC2	LC1	AC220V(1P) model: AC200~240V (50/60Hz)
		LC2	Note: Please confirm the drive power specification when wiring
Motor power output	U/V/W	U	Motor power U phase output
		V	Motor power V-phase output
		W	Motor power W phase output
Encoder	CN2	VCC	Encoder power supply 5V output
		GND	Signal Ground
		—	—
		—	—
		D+	Encoder signal: serial data+
		D-	Encoder signal: serial data-
		FG	The shield wire is connected to the connector shell
Communication	CN6A/CN6B	-	EtherCAT communication interface
User I/O	CN1	Refer to 2.6 Input and output signal (CN1) wiring details	
Brake	CN10	1	Brake + 24V power supply
		2	Brake 0V
		3	BKA+
		4	BKA-
		5	BKB+
		6	BKB-
Ground terminal	⏚	Connect to the ground terminal of the power supply and the servo motor for grounding.	

Note: Do not short-circuit B1/B2, the servo unit may be damaged.

2.5 SIZE B AC380V (3P+N) servo unit components introduction diagram

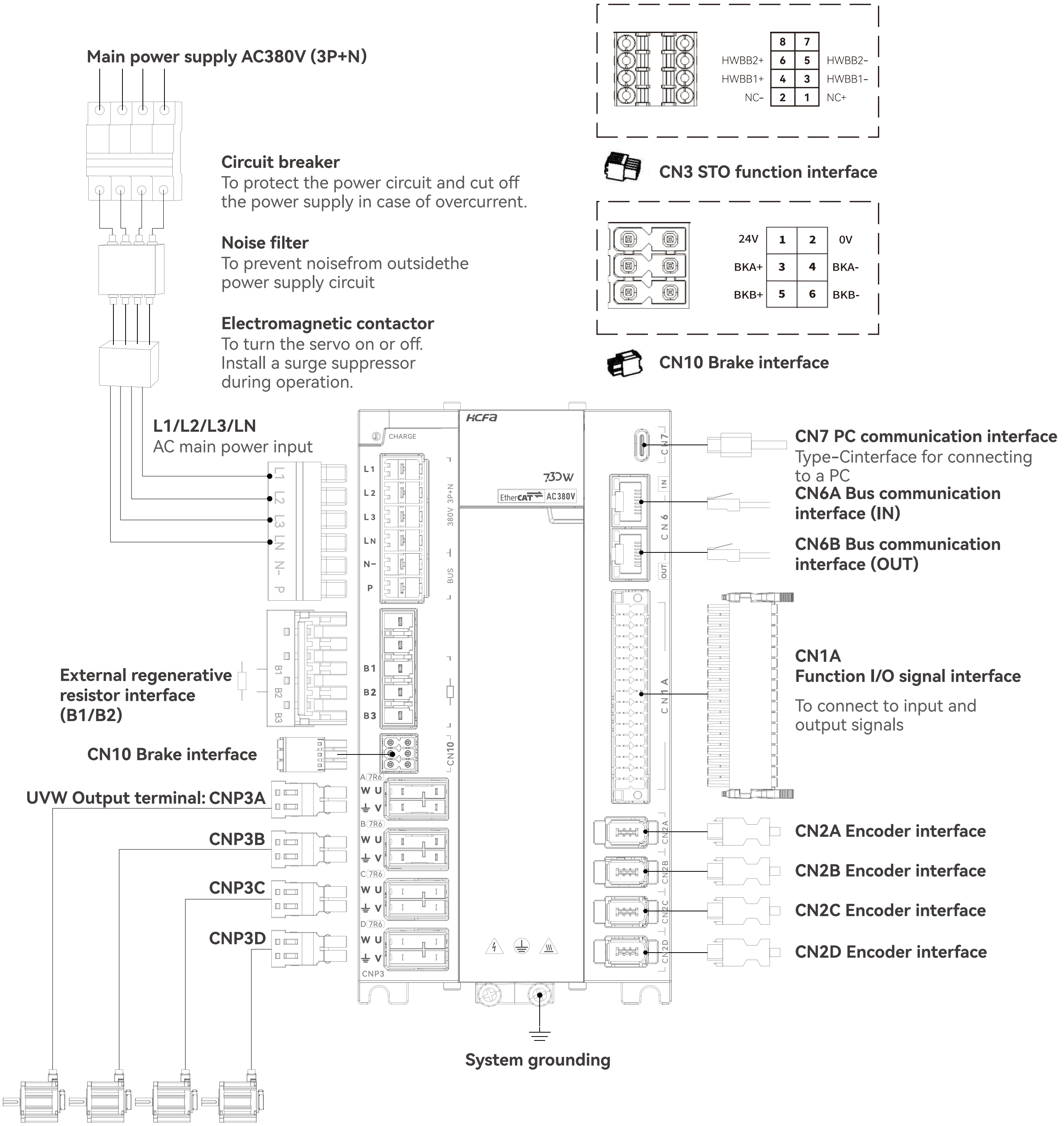


Figure 2-4 SIZE B AC380V (3P+N) Drive Terminal Wiring Diagram

Table 2-6 Terminal Symbols and Terminal Names for SIZE A AC380V (3P+N)

Terminal name	Terminal symbols	Signal name/ pin number	Content
Regenerative resistor	B1/B2/B3	B1	External regenerative resistor interface , main circuit bus+
		B2	External regenerative resistor interface
		B3	Built-in regenerative resistor interface
Main circuit bus	N-/P	N-	Main circuit bus -
		P	Main circuit bus+
AC main circuit power input	L1/L2/L3/LN	L1	AC380V(3P+N) model: AC330~440V (50/60Hz) Note: Please confirm the drive power specification when wiring
		L2	
		L3	
		LN	
Motor power output	U/V/W	U	Motor power U phase output
		V	Motor power V-phase output
		W	Motor power W phase output
Encoder	CN2	VCC	Encoder power supply 5V output
		GND	Signal Ground
		—	—
		—	—
		D+	Encoder signal: serial data+
		D-	Encoder signal: serial data-
		FG	The shield wire is connected to the connector shell
Communication	CN6A/CN6B	-	EtherCAT communication interface
User I/O	CN1	Refer to 2.6 Input and output signal (CN1) wiring details	
Brake	CN10	1	Brake + 24V power supply
		2	Brake 0V
		3	BKA+
		4	BKA-
		5	BKB+
		6	BKB-
Ground terminal	⏚	Connect to the ground terminal of the power supply and the servo motor for grounding.	

Note: Do not short-circuit B1/B2, the servo unit may be damaged.

2.6 Main circuit wiring

When turning on the power, please consider the following points.

• Please ensure the following design when the power is turned on: After outputting the signal of "servo alarm", turn OFF the main circuit power supply.

• When the control power supply is turned on, the ALM signal is output (relay: OFF) for up to 5.0 seconds. Please take it into consideration when designing the power-on sequence, and turn off the main circuit power connected to the servo unit through the relay.

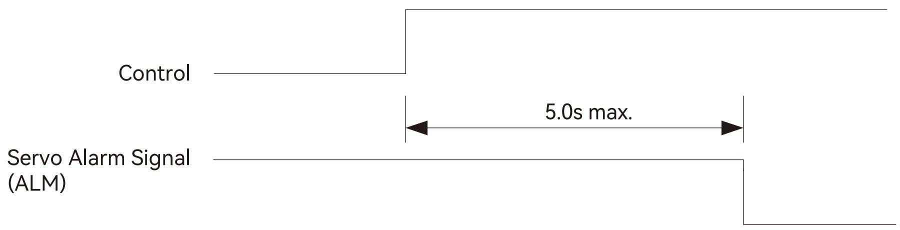


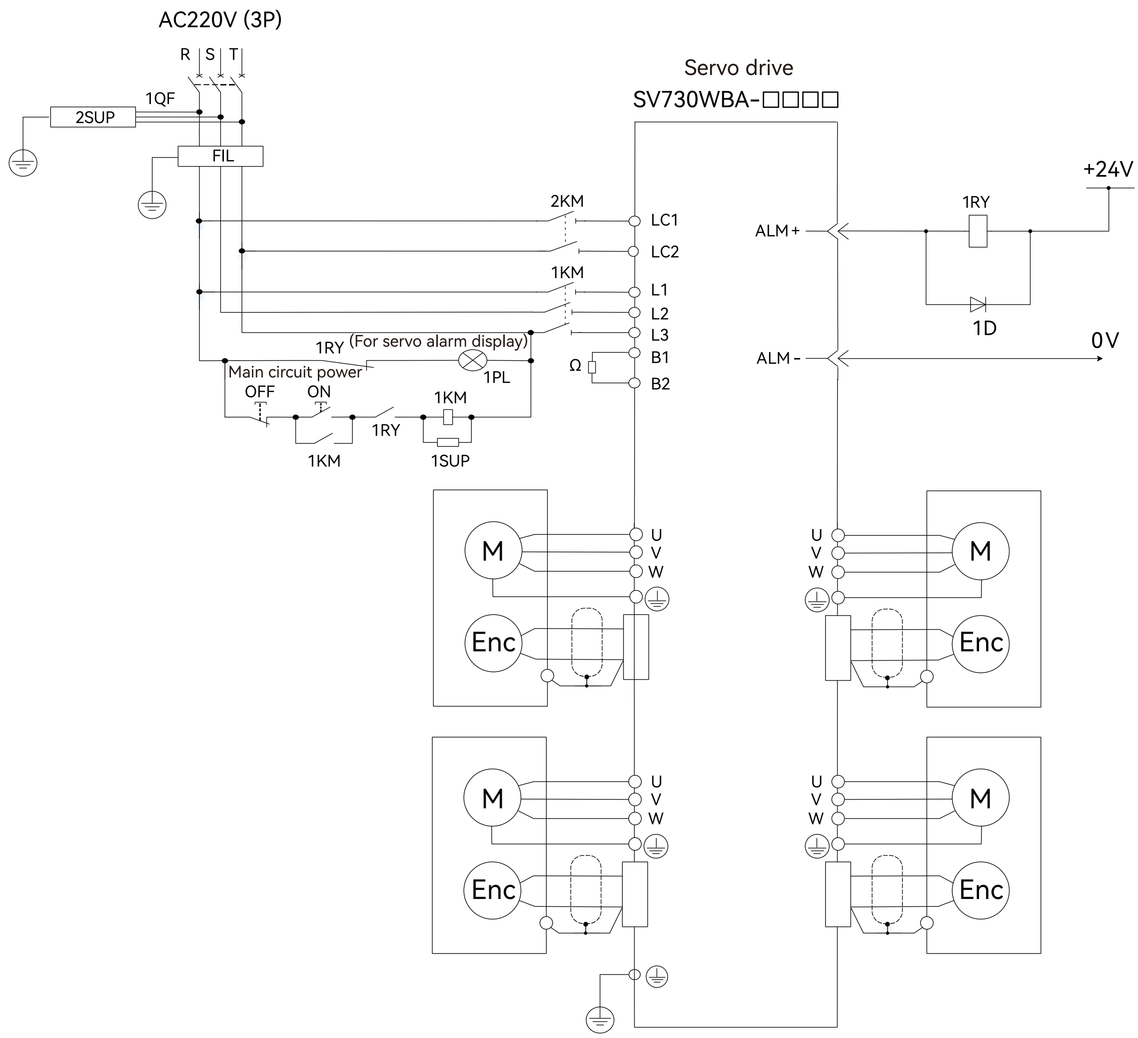
Figure 2-5 Servo Alarm Signal Timing Chart

- The power rating of the components must match the input power supply.

Points	• Turn ON the control power supply before the main circuit power supply or turn ON the control power supply and the main circuit power supply at the same time. Turn OFF the main circuit power supply first, and then turn OFF the control power supply.

2.6.1 Example of main circuit wiring for standard AC220V(3P) power input

Model name: SV730WBA-CCCC, SV730WBA-GGGG



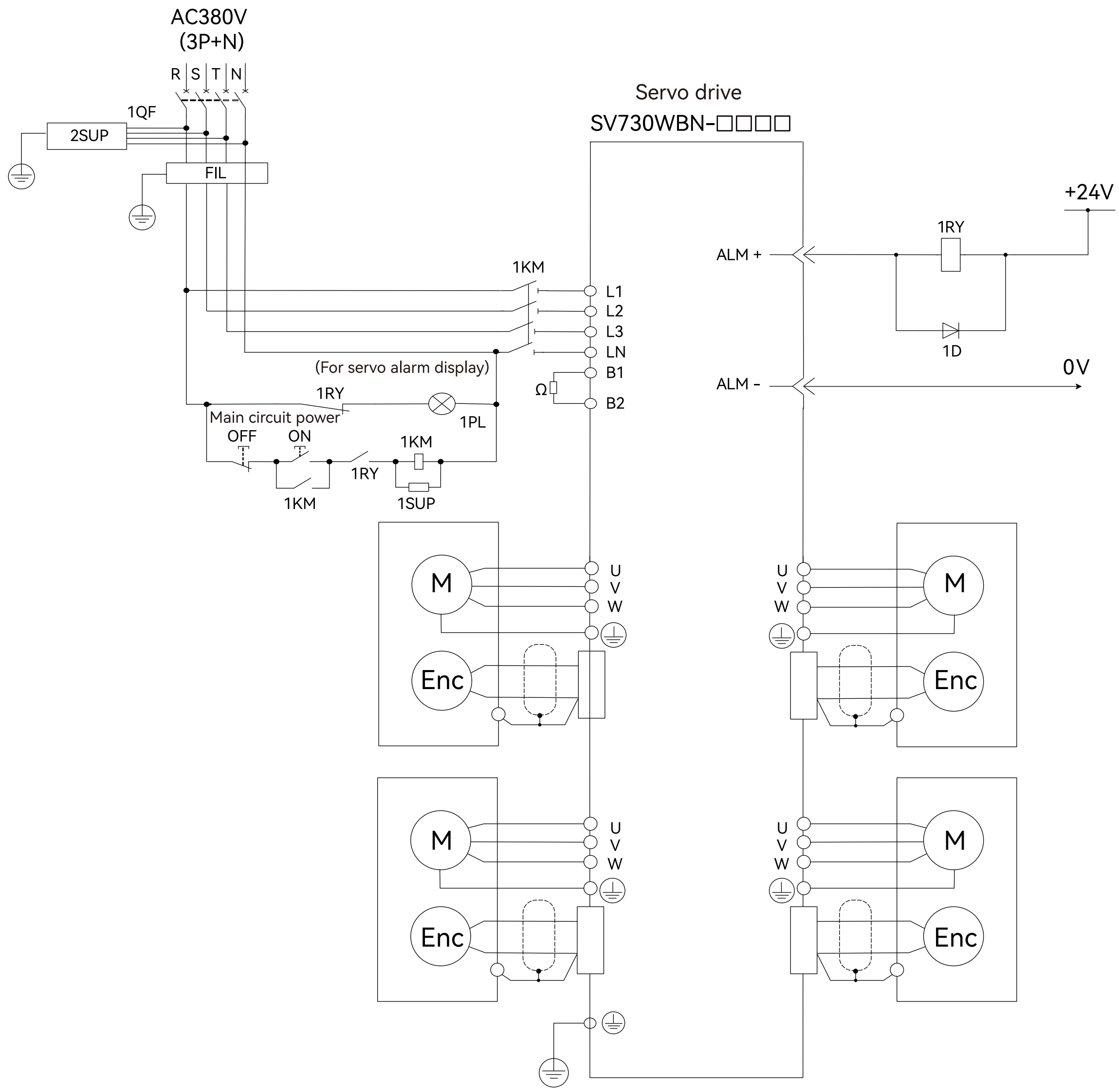
1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor(Main circuit power)
2KM: Magnetic contactor(Control power)
Ω: Brake resistor

1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber
1D: Flywheel diode

Figure 2-6 AC220V 3P Wiring

2.6.2 Example of main circuit wiring for standard AC380V(3P+N) power input

Model Name: SV730WBN-CCCC, SV730WBN-GGGG



1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor
Ω: Brake resistor
1D: Flywheel diode

1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber

Figure 2-7 AC380V 3P+N Wiring

2.6.3 Servo drive of single-phase 220V power input

The 730W series 220V power supply input type servo unit has a three-phase power input specification, and there are also models that can be used under a single-phase 220V power supply. When using the main circuit power supply of the above servo unit under the single-phase 220V power supply, please change it to Pn00B.2=1 (support single-phase power input).

I. Parameter setting for single-phase power input

Table 2-7 Parameter Setting for Single-phase Power Input

Parameter		Meaning	When enabled	Classification
Pn00B	n. □ 0 □□ [Default value]	Use with three-phase power input	After restart	Setup
	n. □ 1 □□	Use with single-phase power input		

Please observe the following precautions when using.

DANGER ⚠

・ When using a servo unit that supports single-phase 220V power input, if you directly input single-phase power without changing the parameter setting to Pn00B.2=1 (supporting single-phase power input), a power phase loss alarm (A.F10) will be detected.

・ Single-phase power input is not supported, except for servo units that are suitable for single-phase 220V power input. Otherwise power phase loss alarm (A.F10) will be detected.

・ When using single-phase 220V power input, the torque/speed characteristics of the servo motor sometimes cannot meet the characteristics of three-phase power input.

II. Main circuit power input

When the power supply is single-phase 220V, please connect it to the L1 and L2 terminals. The power specifications other than the main circuit power input are the same as three-phase power input.

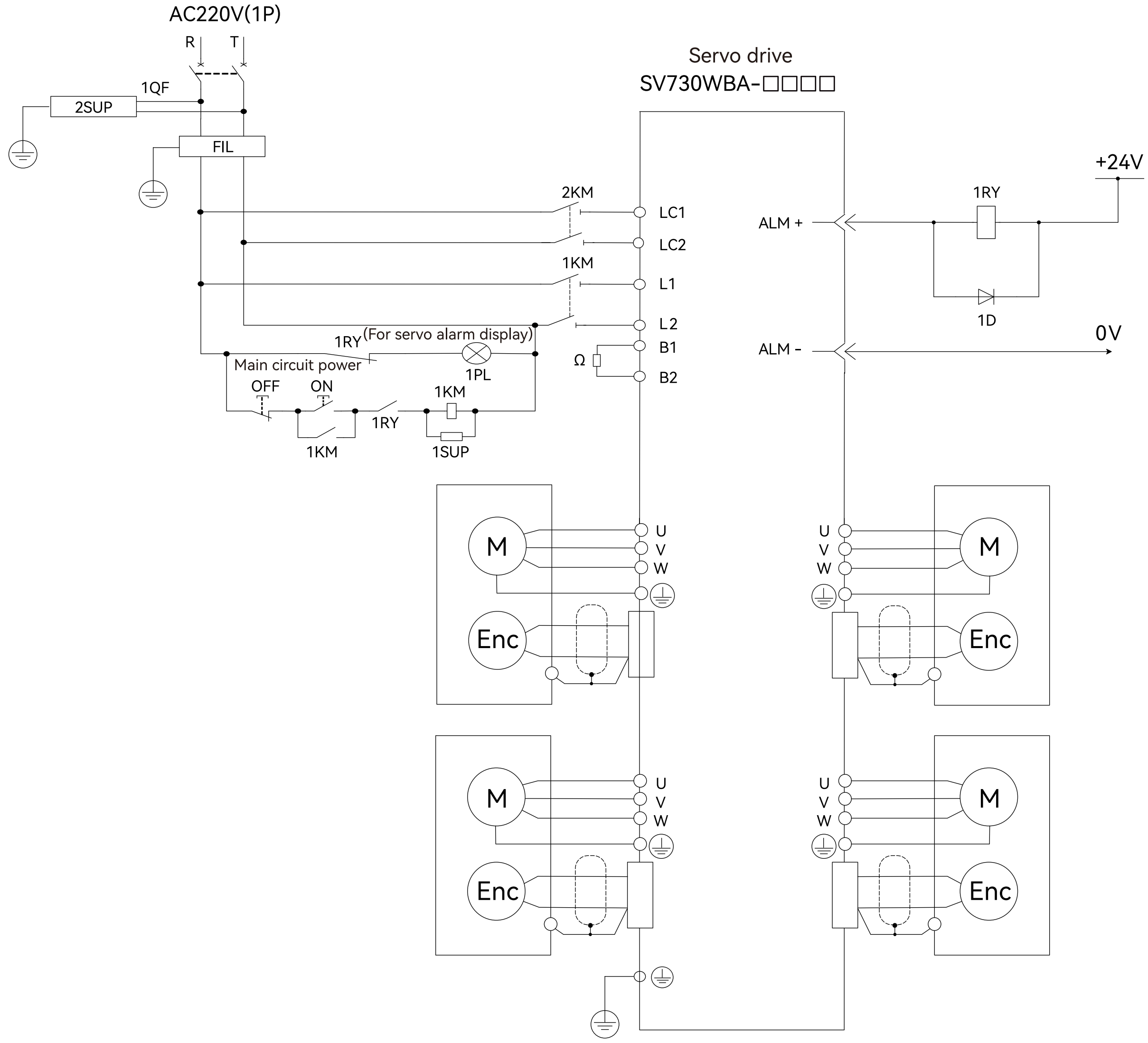
Table 2-8 Main Circuit Power Input Terminal

Terminal	Name	Function, rating
L1, L2	Main circuit power input terminal	Single-phase 200V ~ 240V (50/60Hz)
L3	—	N/A

Note: Do not connect to L3 terminal.

III. Wiring example for single-phase 220V(1P) power input

Model name: SV730WBA-CCCC, SV730WBA-GGGG



1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor(Main circuit power)
2KM: Magnetic contactor(Control power)
Ω: Brake resistor
1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber
1D: Flywheel diode

Figure 2-8 Signal-phase 220V Wiring

2.6.4 Servo unit of DC power input

I. Parameter setting for DC power input

Before using the servo unit with DC power input, be sure to change the parameter to Pn001.2 =1 (support DC power input)

Table 2-9 DC Power Supply Settings

Parameter		Meaning	When enabled	Classification
Pn001	n. □ 0 □□ [Default value]	DC Power Input Unsupported: Input AC power from the L1, L2, and L3 terminals	After restart	Setup
	n. □ 1 □□	DC Power Input Supported: Input DC power directly from B1 and N, or directly from P and N		

Please observe the following precautions when using.

DANGER ⚠

- Both 220V and 380V servo unit support AC/DC power input. Please ensure to set Pn001.2=1(Support DC power input) before inputting the power supply.
- Otherwise it will cause the elements in servo unit to burn out and result in fire or device damage.
- Even after you turn OFF the power supply, a high residual voltage may still remain in the servo unit. To prevent electric shock, do not touch the power supply terminals after you turn OFF the power. Make sure to discharge after the power is cut off.
- Please install a fuse on the power wiring when DC power is input.
- The servo motor returns regenerative energy to the power supply. If you use a servo unit with a DC power supply input, regenerative energy is not processed. Process the regenerative energy at the power supply.
- If you use a DC power supply input, externally connect an inrush current limiting circuit. Otherwise will cause damage to the servo unit.

II. Main circuit and control power input

AC220V 730W series

Model name: SV730WBA-CCCC

Table 2-10 DC310V SV730WBA-CCCC Power Input Terminals

Terminal	Name	Specification
B1	Main circuit positive side terminal	DC280 ~ 360V
N-	Main circuit negative side terminal	0V
LC1, LC2	Control power terminal	AC220V

Model name: SV730WBA-GGGG

Table 2-11 DC310V SV730WBA-GGGG Power Input Terminals

Terminal	Name	Specification
P	Main circuit positive side terminal	DC280 ~ 360V
N-	Main circuit negative side terminal	0V
LC1, LC2	Control power terminal	AC220V

AC380V(3P+N) 730W series

Model name: SV730WBN-CCCC

Table 2-12 DC310V SV730WBN-CCCC Power Input Terminals

Terminal	Name	Specification
B1	Main circuit positive side terminal	DC280 ~ 360V
N-	Main circuit negative side terminal	0V

Model name: SV730WBN-GGGG

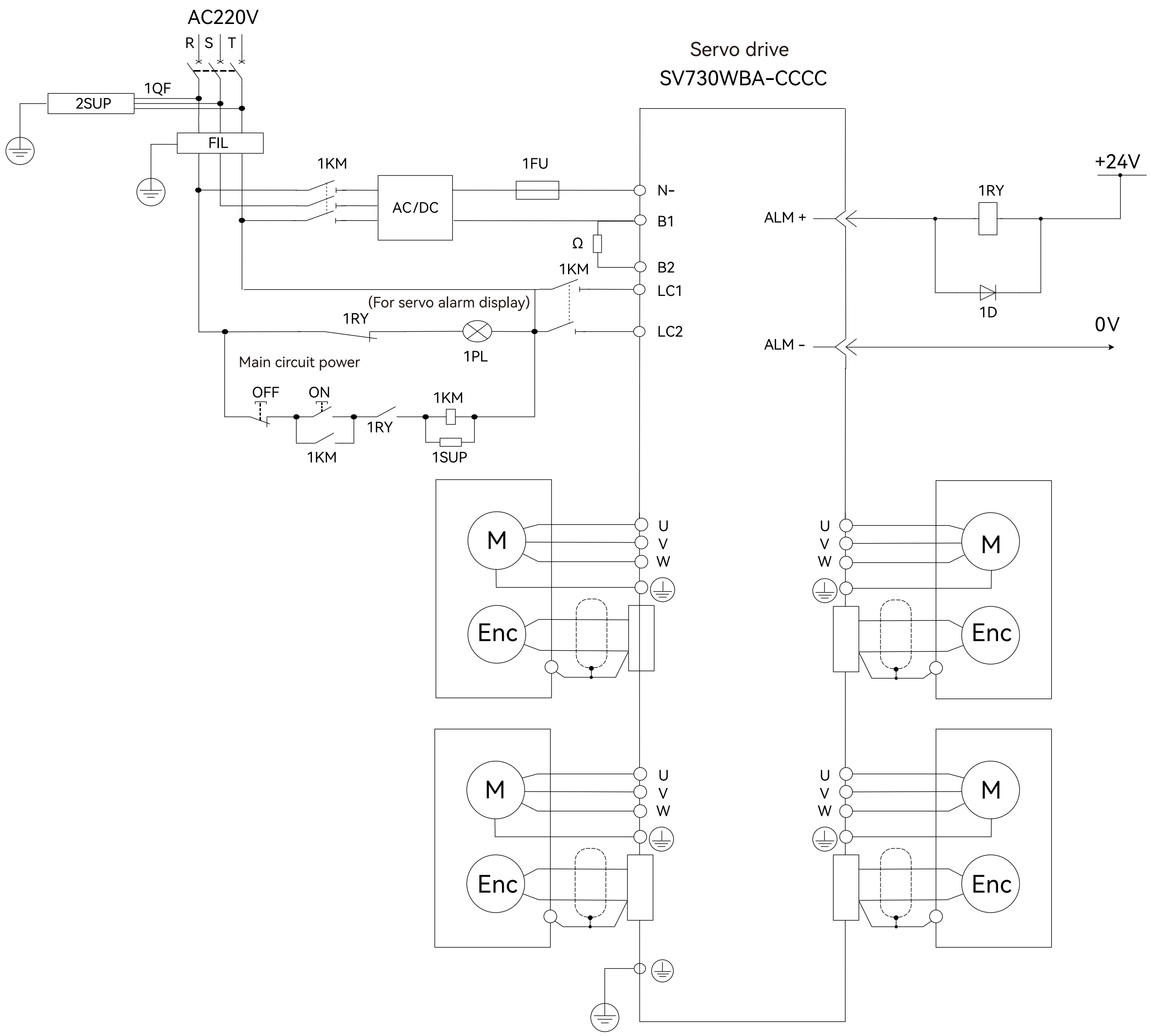
Table 2-13 DC310V SV730WBN-GGGG Power Input Terminals

Terminal	Name	Specification
P	Main circuit positive side terminal	DC280 ~ 360V
N-	Main circuit negative side terminal	0V

III. Wiring example for DC power input

Wiring for SV730WBA- □□□□ DC310V power input type servo unit

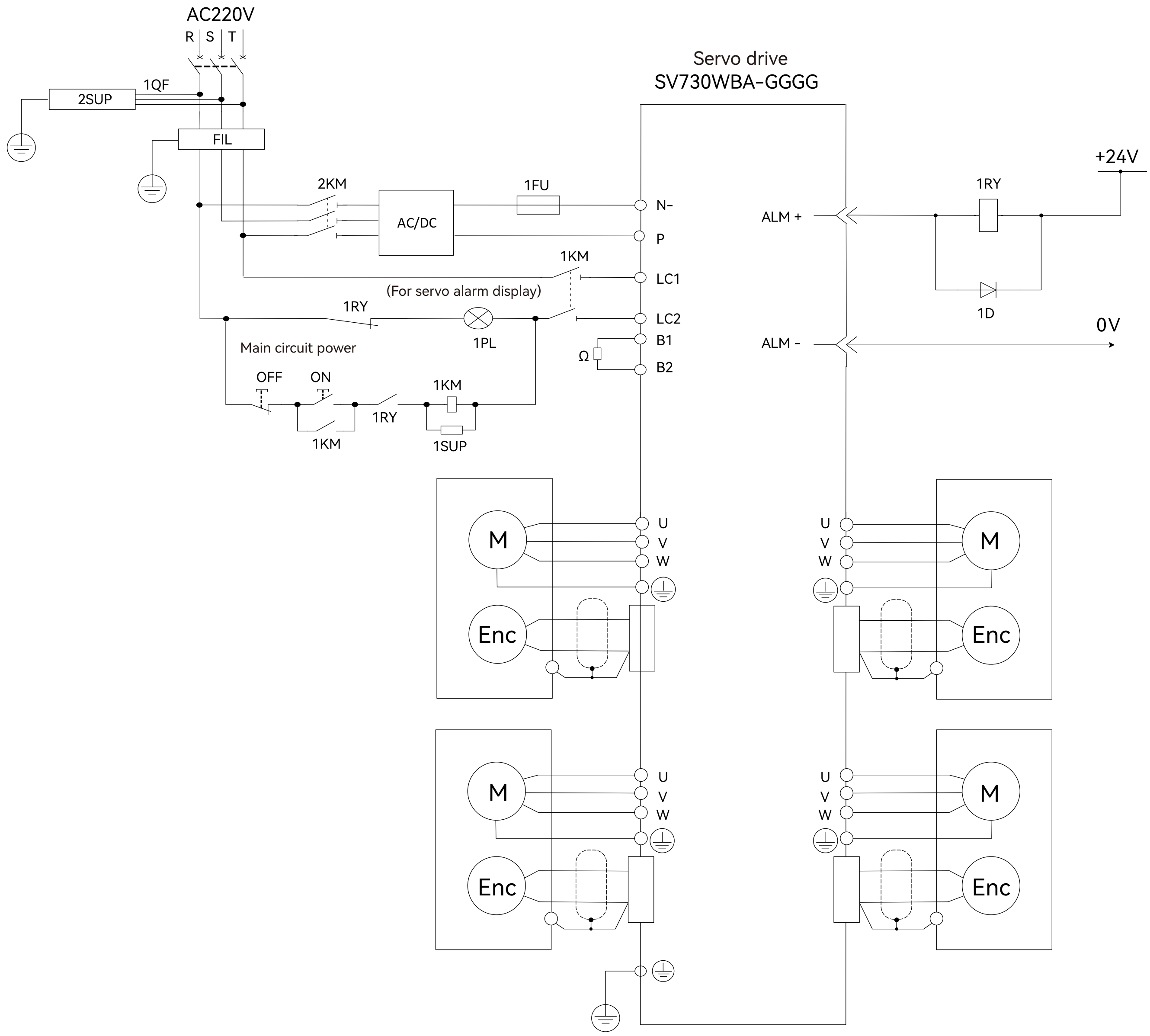
Model name: SV730WBA-CCCC



1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor(Main circuit power)
2KM: Magnetic contactor(Control power)
Ω: Brake resistor
1FU:Fuse
1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber
1D: Flywheel diode

Figure 2-9 DC310V Input SV730WBA-CCCC Wiring

Model name: SV730WBA-GGGG



1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor(Main circuit power)
2KM: Magnetic contactor(Control power)
Ω: Brake resistor
1FU:Fuse

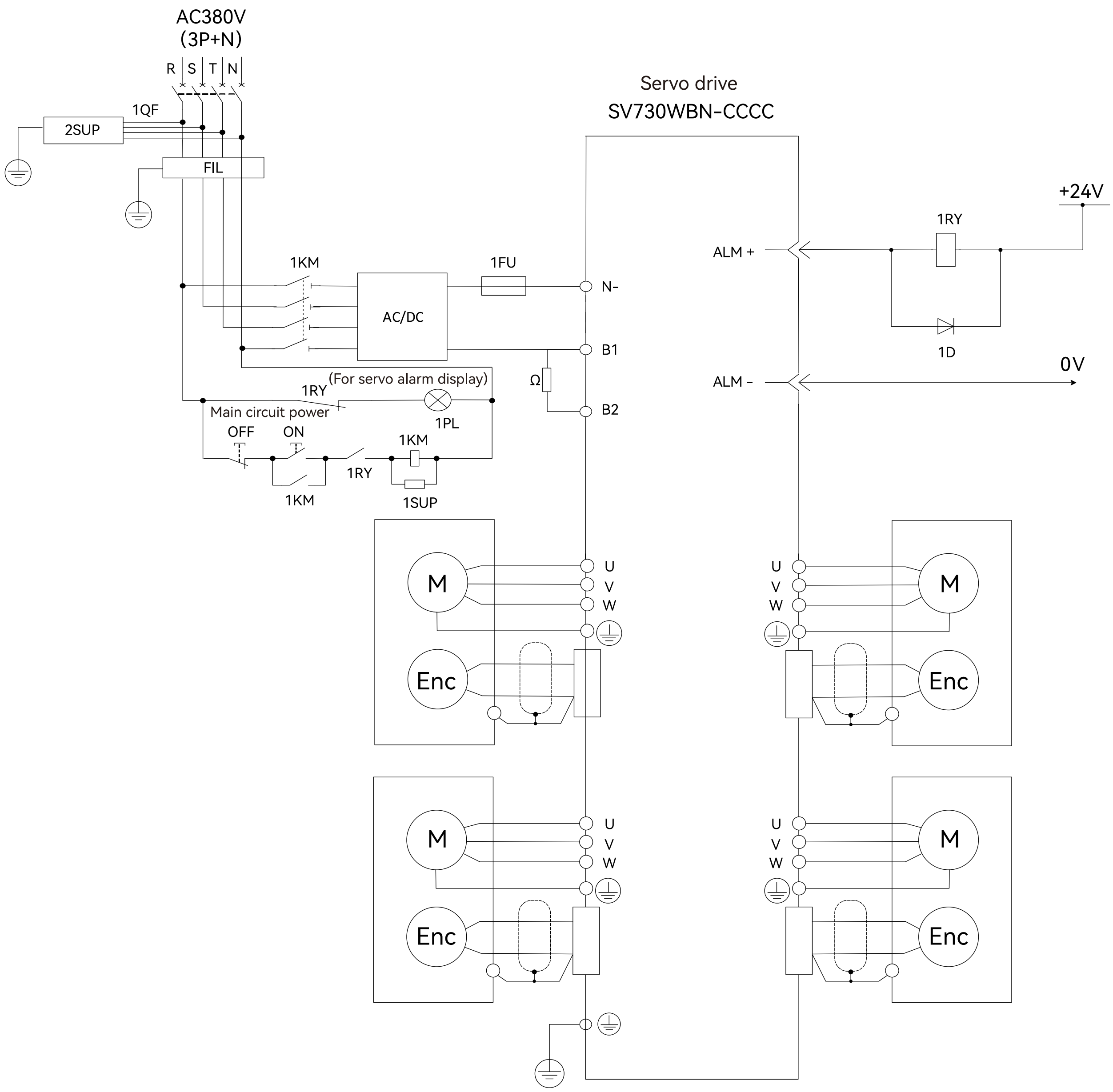
1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber
1D: Flywheel diode

Figure 2-10 DC310V Input SV730WBA-GGGG Wiring

Note: The terminals are different according to the model of the servo unit. Please refer to the table in "(2) Main circuit, control power input".

Wiring for SV730WBN- □□□□ DC310V power input type servo unit

Model name: SV730WBN-CCCC

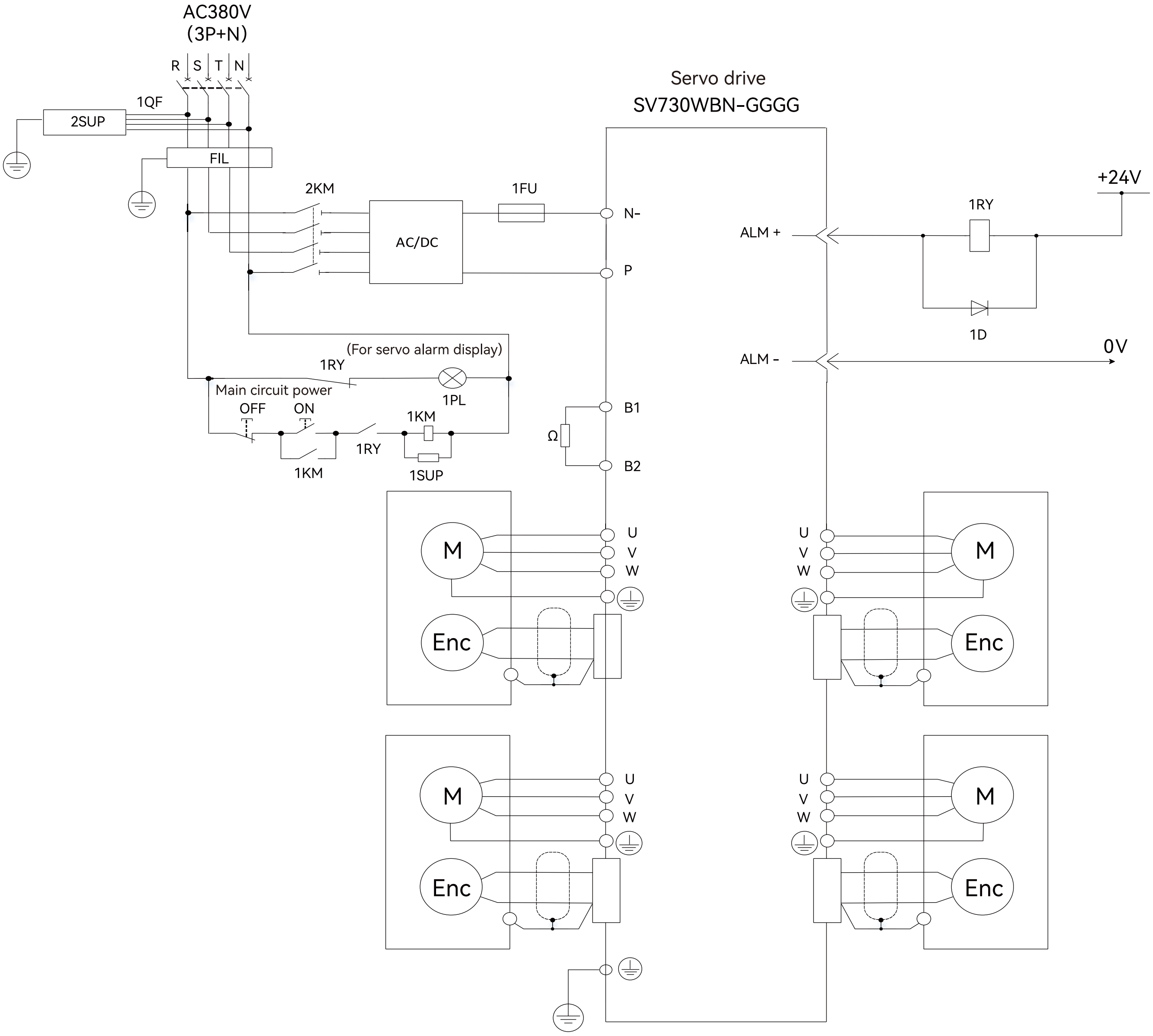


1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor
Ω: Brake resistor
1D: Flywheel diode

1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber
1FU:Fuse

Figure 2-11 DC310V Input SV730WBN-CCCC Wiring

Model name: SV730WBN-GGGG



1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor
Ω: Brake resistor
1D: Flywheel diode

1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber
1FU:Fuse

Figure 2-12 DC310V Input SV730WBN-GGGG Wiring

2.6.5 Line breaker and fuse capacity

Table 2-14 Circuit Breaker and Fuse Capacity Table for Servo Unit Wiring

Main circuit power supply	Maximum applicable motor capacity (kW)	Servo Drive 730W	Power supply capacity for single servo unit (kVA)	Current capacity		Impulse current	
				Main circuit Arms	Control loop Arms	Main circuit Ap-p	Control loop Ap-p
AC220V 1P/3P	1.6	CCCC	3.2	7.3	0.25	33	33
	4	GGGG	7.6	19.2	0.4	33	33
AC380V 3P+N	1.6	CCCC	3.2	7.3	Same as main circuit	33	Same as main circuit
	4	GGGG	8.5	21.9	Same as main circuit	33	Same as main circuit

Note: 1. In order to meet the low voltage standard, please be sure to connect a fuse on the input side for protection when a fault is caused by a short circuit. Please select the fuse or circuit breaker for the input side to meet the UL standard products. In addition, the current capacity and inrush current in the above table are net values. Please select a fuse and a circuit breaker for wiring that satisfy the following conditions for breaking characteristics.

2. Main circuit and control circuit: When the current value is 3 times the value in the above table, the circuit shall not be disconnected within 5s.

Table 2-15 Restrictions to Comply with UL Standard

Servo Drive SV730WB□-□□□□	Usage restrictions
CCCC	Rated current value of circuit breaker for wiring: 40A or less.
GGGG	The rated current value of circuit breaker for wiring: 60A or less. The rated current value of fast-acting fuse and time-delay fuse: below 60A. The rated current value of the time-delay fuse: below 35A.

2.7 Wiring of regenerative resistor

When the processing capacity of regenerative energy is insufficient, connect an external regenerative resistor according to the following method, and set the regenerative resistor capacity (Pn600) for details.

Note: Please connect the regenerative resistor unit correctly. Do not short-circuit B1/B2. Doing so may result in damage to the regenerative resistor or the servo unit and cause fire.

Generally, directly connect regenerative resistor between B1/B2 terminals. After connecting, please set the regenerative resistor capacity.

The unit with the model HN -Y7 □□ 040A-S does not have a built-in regenerative resistor. If the processing capacity of regenerative energy is insufficient, an external regenerative resistor must be connected.

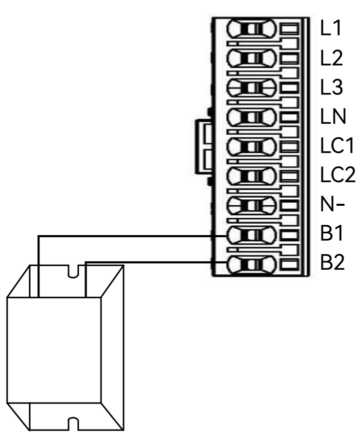


Figure 2-13 SIZE A Regenerative Resistor Wiring

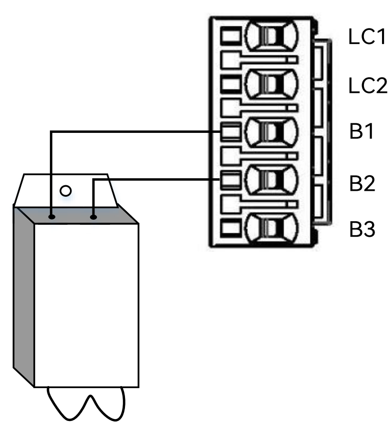


Figure 2-14 SIZE B Regenerative Resistor Wiring (With B3)

2.7.1 AC 220V(1P/3P) regenerative resistor basic specifications

Table 2-16 AC 220V(1P/3P) regenerative resistor basic specifications

Item			Specification	
Model SV730W*A-****			C	G
Regenerative resistor	Built-in resistor	Resistance value (Ω)	—	—
		Capacity (W)	—	—
	External minimum allowable resistance value (Ω)		12	12

2.7.2 AC380V(3P+N) regenerative resistor basic specifications

Table 2-17 AC380V(3P+N) regenerative resistor basic specifications

Item			Specification	
Model SV730W*N-****			C	G
Regenerative resistor	Built-in resistor	Resistance value (Ω)	—	—
		Capacity (W)	—	—
	External minimum allowable resistance value (Ω)		12	12

Points

- If using an external regenerative resistor at a normal rated load factor, the temperature of the resistor reaches 200° C to 300° C, please be sure to derate before using it. For the load characteristics of the resistor, please consult the manufacturer
- To ensure safety, recommend to use external regenerative resister with temperature-controlled switch.

2.8 Input and output signals (CN1)

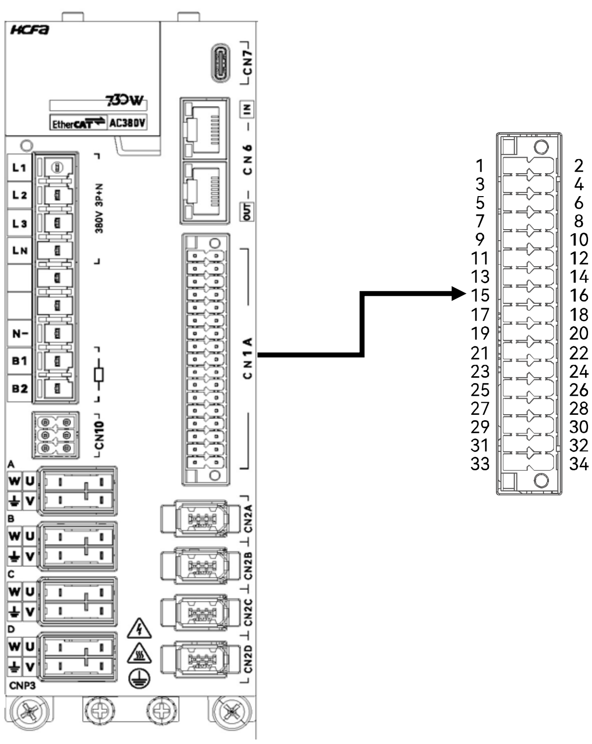


Figure 2-15 CN1 External View

2.8.1 Pin arrangement of I/O signal (CN1) connector

Table 2-18 Pin arrangement of I/O signal (CN1) connector

NO	Signal	Function	IO	NO	Signal	Function	IO
1	COM-	Output common 1	P	2	COM+	Input common 1	P
3	DO8	D-axis alarm signal	O	4	DO7	D-axis servo ready	O
5	DO6	C-axis alarm signal	O	6	DO5	C-axis servo ready	O
7	DO4	B-axis alarm signal	O	8	DO3	B-axis servo ready	O
9	DO2	A-axis alarm signal	O	10	DO1	A-axis servo ready	O
11	DI21	Emergency stop	I	12	DI20	D-axis home switch	I
13	DI19	D-axis probe1	I	14	DI18	D-axis probe 0	I
15	DI17	D-axis negative over travel switch	I	16	DI16	D-axis positive over travel switch	I
17	COM-	Output common 1	P	18	24V	24V input	—
19	DI15	C-axis home switch	I	20	DI14	C-axis probe 1	I
21	DI13	C-axis probe 0	I	22	DI12	C-axis negative over travel switch	I
23	DI11	C-axis positive over travel switch	I	24	DI10	B-axis home switch	I
25	DI9	B-axis probe 1	I	26	DI8	B-axis probe 0	I
27	DI7	B-axis negative over travel switch	I	28	DI6	B-axis positive over travel switch	I
29	COM+	Input common 1	P	30	DI5	A-axis home switch	I
31	DI4	A-axis probe 1	I	32	DI3	A-axis probe 0	I
33	DI2	A-axis negative over travel switch	I	34	DI1	A-axis positive over travel switch	I

Note:

1. I/O pin functions are assignable.

2. When using the input function, 24V must be connected to COM+, and the input pins must be connected to 24V ground (0V).

3. When using the output function, pin 18 must be connected to 24V, COM- must be connected to 24V ground (0V). The output pins can be connected to pin 18 via a relay or a parallel resistor.

4. The probe function can only be assigned to pins 13, 14, 20, 21, 25, 26, 31, and 32.

2.8.2 Name and function of input signal (CN1)

Table 2-19 Input signal (CN1) name and function list

<table>
<tr><th>Control Method</th><th>Signal</th><th>A-axis pin No.</th><th>B-axis pin No.</th><th>C-axis pin No.</th><th>D-axis pin No.</th><th colspan="2">Function</th></tr>
<tr><td rowspan="6">Any Control Method</td><td>HomeSwich</td><td>30</td><td>24</td><td>19</td><td>12</td><td colspan="2">Homing signal drive input</td></tr>
<tr><td>LATCH0</td><td>32</td><td>26</td><td>21</td><td>14</td><td colspan="2">Probe 0</td></tr>
<tr><td>P-OT</td><td>34</td><td>28</td><td>23</td><td>16</td><td>Prohibition of forward drive</td><td rowspan="2">When the mechanical movement exceeds the movable range, the drive of the servo motor is stopped (overtravel prevention function).</td></tr>
<tr><td>N-OT</td><td>33</td><td>27</td><td>22</td><td>15</td><td>Prohibition of reverse drive</td></tr>
<tr><td>LATCH1</td><td>31</td><td>25</td><td>20</td><td>13</td><td colspan="2">Probe 1</td></tr>
<tr><td>DI(COM+)</td><td colspan="4">2/29</td><td colspan="2">(Note)Available when the control power supply is used for the input signal.
Operable voltage range: +11V ~ +25V (+24V power supply is not provided by HCFA) .</td></tr>
</table>

Note: The input signal distribution of P-OT, N-OT and probe is changeable, please refer to 2.8.3 "Allocation of input signal " for details.

2.8.3 Allocation of input signal

Points

- If you change the default polarity settings for the P-OT (Positive Overtravel Switch), or N-OT (Reverse Overtravel Switch) signal, the main circuit power supply will not be turned OFF and the overtravel function will not operate if there are signal line disconnections or other problems. If you must change the polarity of one of these signals, verify operation and make sure that no safety problems will exist.
- If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be used and all of the allocated signals will operate accordingly. This may result in unexpected operation.

The servo allows the allocation of input signals to be changed.

Table 2-20 Input signal allocation

Default axis number	Signal	Related parameters	CN1 pin numbers and corresponding parameter assignments (n.□□xx)					Polarity control (n.□x□□)				Axis select (n.x□□□)				
			30	31	32	33	34	Active level H	Active level L	Always valid	Always invalid	A-axis	B-axis	C-axis	D-axis	All axes
A-axis	HomeSwitch	Pn594	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH1	Pn593	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH0	Pn592	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	N-OT	Pn591	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	P-OT	Pn590	01	02	03	04	05	0	1	3	2	1	2	3	4	5

Default axis number	Signal	Related parameters	CN1 pin numbers and corresponding parameter assignments (n.□□xx)					Polarity control (n.□x□□)				Axis select (n.x□□□)				
			24	25	26	27	28	Active level H	Active level L	Always valid	Always invalid	A-axis	B-axis	C-axis	D-axis	All axes
B-axis	HomeSwitch	Pn599	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH1	Pn598	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH0	Pn597	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	N-OT	Pn596	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	P-OT	Pn595	01	02	03	04	05	0	1	3	2	1	2	3	4	5

Default axis number	Signal	Related parameters	CN1 pin numbers and corresponding parameter assignments (n.□□xx)					Polarity control (n.□x□□)				Axis select (n.x□□□)				
			19	20	21	22	23	Active level H	Active level L	Always valid	Always invalid	A-axis	B-axis	C-axis	D-axis	All axes
C-axis	HomeSwitch	Pn59E	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH1	Pn59D	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH0	Pn59C	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	N-OT	Pn59B	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	P-OT	Pn59A	01	02	03	04	05	0	1	3	2	1	2	3	4	5

Default axis number	Signal	Related parameters	CN1 pin numbers and corresponding parameter assignments (n.□□xx)					Polarity control (n.□x□□)				Axis select (n.x□□□)				
			12	13	14	15	16	Active level H	Active level L	Always valid	Always invalid	A-axis	B-axis	C-axis	D-axis	All axes
D-axis	HomeSwitch	Pn5A3	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH1	Pn5A2	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	LATCH0	Pn5A1	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	N-OT	Pn5A0	01	02	03	04	05	0	1	3	2	1	2	3	4	5
	P-OT	Pn59F	01	02	03	04	05	0	1	3	2	1	2	3	4	5

Note:

1. □ in table indicates default setting

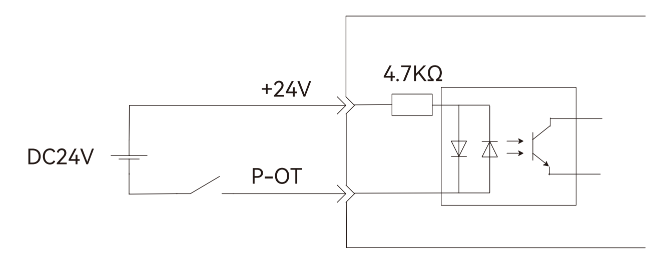
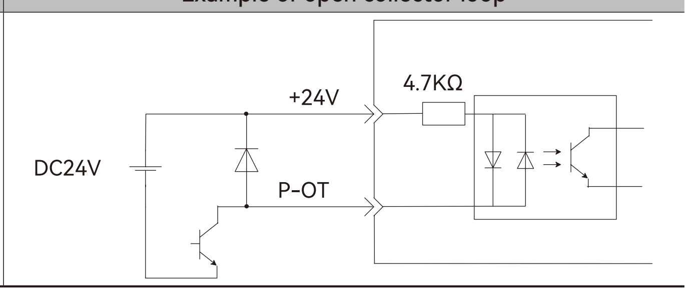
2. If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be used and all of the allocated signals will operate accordingly. This may result in unexpected operation.

2.8.4 Input circuit

The following describes terminals 3 to 10 of the CN1 port

I. Relay/collector input circuit

The connection is made via a relay or an open-collector transistor circuit. When using a relay connection, please choose a relay for small current; if you do not use a relay for small current, it will cause poor contact

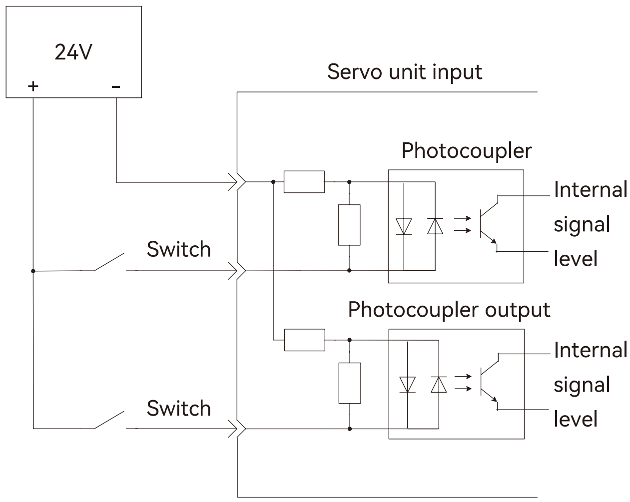
Example of a relay circuit	Example of open collector loop
	

Note: The external power supply (DC24V) must be a capacity of 50mA or more.

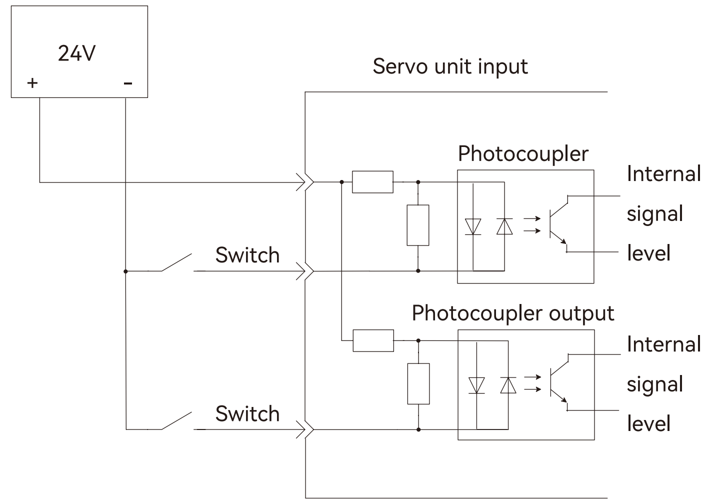
II. Photocoupler input circuit

The input circuit of the servo unit uses a bidirectional photocoupler. Please choose NPN connection or PNP connection according to the specifications of the machine.

PNP



NPN



PNP: Input Signal Polarity		NPN: Input Signal Polarity	
Signal	**Active level**	**Signal**	**Active level**
OFF	L level	OFF	H level
ON	H level	ON	L level

Note: Please note that the ON/OFF polarity is different between NPN circuit connection and PNP circuit connection.

2.8.5 Name and function of output signal (CN1)

Table 2-21 Names and functions of output signals (CN1)

Control Method	Signal	A-axis pin No.	B-axis pin No.	C-axis pin No.	D-axis pin No.	Function
Any control method	S_RDY	10	8	6	4	The Servo Ready output signal is also user-assignable.
	ALM	9	7	5	3	The Alarm output signal is also user-assignable.
	FG	Shell				Ground is already performed if IO signal is connected to the shell with shield of cables

2.8.6 Allocation of output signal

Points	
Points	• The signals that are not detected are considered to be OFF. For example, the /COIN (Positioning Completion) signal is considered to be OFF during speed control. • Reversing the polarity of the /BK (Brake) signal, i.e., changing it to positive logic, will prevent the holding brake from operating if its signal line is disconnected. If you must change the polarity of this signal, verify operation and make sure that no safety problems will exist. • If you allocate more than one signal to the same output circuit, a logical OR of the signals will be output.

The allocation of the output signals is shown in the table below:

Table 2-22 Output signal parameter allocation

	Bit0~1 Signal allocation definition		Bit2 Polarity control definition		Bit3 Axis selection definition	
Pn5B0~Pn5B7	n. □□ 00	Not defined	n. □ 0 □□	Signal not inverted (Same polarity)	n.0 □□□	Disabled
	n. □□ 01	Positioning completion	n. □ 1 □□	Signal inverted (Opposite polarity)	n.1 □□□	A-axis
	n. □□ 02	Speed coincidence match	n. □ 2 □□	Force inactive	n.2 □□□	B-axis
	n. □□ 03	Motor rotation	n. □ 3 □□	Force active	n.3 □□□	C-axis
	n. □□ 04	Servo ready			n.4 □□□	D-axis
	n. □□ 05	Torque limiting			n.5 □□□	All axes
	n. □□ 06	Speed limiting				
	n. □□ 07	Brake				
	n. □□ 08	Warning				
	n. □□ 09	Position near				
	n. □□ 10	Position compare output 1				
	n. □□ 11	Position compare output 2				
	n. □□ 12	Position compare output 3				
	n. □□ 13	Position compare output 4				
	n. □□ 14	Alarm signal				
	n. □□ 15	User-defined signal 1				
	n. □□ 16	User-defined signal 2				
	n. □□ 17	User-defined signal 3				

If you allocate more than one signal to the same output circuit, a logical OR of the signals will be output.

Reversing the polarity of the /BK (Brake) signal, i.e., changing it to positive logic, will prevent the holding brake from operating if its signal line is disconnected. If you must change the polarity of this signal, verify operation and make sure that no safety problems will exist.

Note: Output signals above are only for example. Please self-allocate as appropriate.

2.8.7 Output circuit

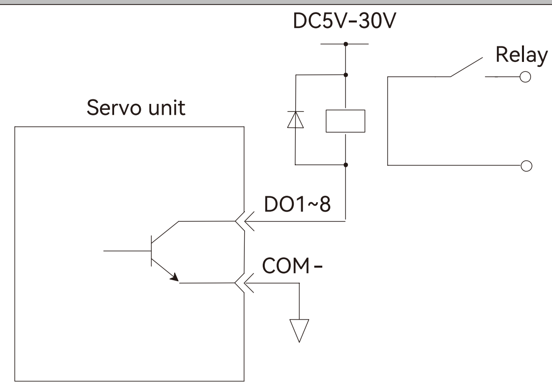
The signal output circuits of the servo unit are the following one type.

Points	• Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury.

(一). Photocoupler output circuit

Photocoupler output circuits are used for the ALM (Servo Alarm) and other sequence output signals. Connect a photocoupler output circuit to a relay circuit.

Example of a Relay Circuit



Note: 1. The specifications of the photocoupler output circuit are as follows:

- Maximum allowable voltage: DC30V
- Current range: DC5mA ~ DC50mA

2. High-speed output:D01,3,5,7;General output:DO2,4,6,8

2.8.8 Brake signal

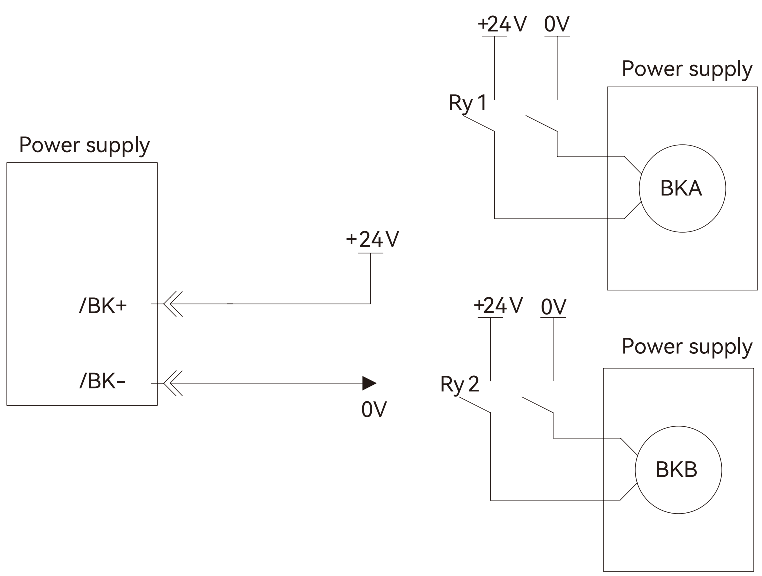


Figure 2-16 Brake signal connection

Note: 1. The /BK (Brake) signal cannot be used with the default settings. You must allocate the output signal. Please use "brake signal (/BK) distribution" to set.

2. If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is Common, the I/O signals may malfunction.

2.9 Encoder signal (CN2)

The following describes the name, function and connection example of encoder signal(CN2).

2.9.1 Name and function of encoder signal (CN2)

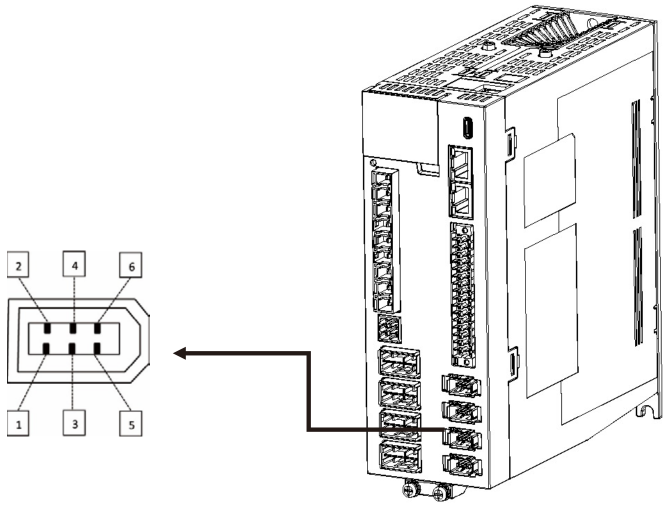


Figure 2-17 Pin arrangement of encoder connector

Table 2-23 Name and function table of encoder signal (CN2)

Signal name	Pin number	Function
PG 5V	1	Encoder Power +5V
PG 0V	2	Encoder Power 0V
—	3	—
—	4	—
PS	5	Serial Data (+)
/PS	6	Serial Data (-)
Shield	Shell	—

2.9.2 Wiring the servo drive to encoder

The wiring example of the encoder, servo drive and host device is shown below.

(一). Incremental encoder

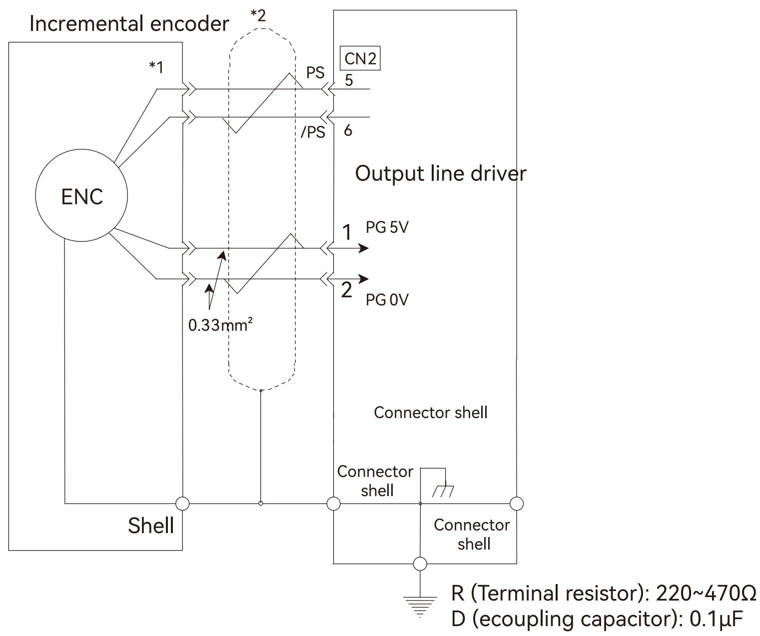


Figure 2-18 Incremental encoder and servo drive connection diagram

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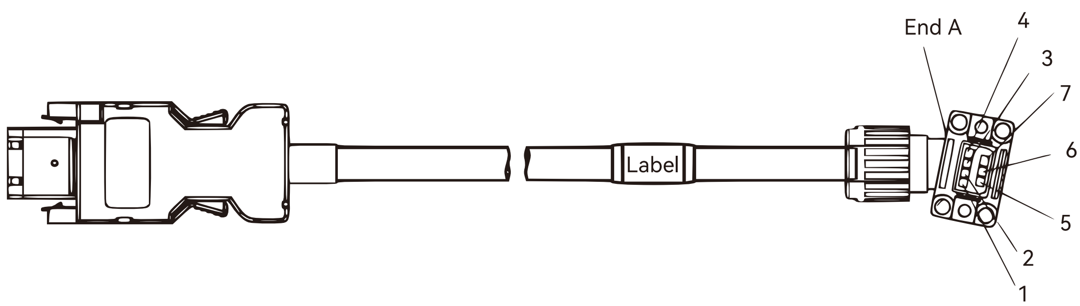
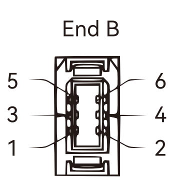
Note: *1. The connector wiring pin number of the incremental encoder varies depending on the servo motor used.

*2. Indicates shielded twisted-pair wire.

◆ Incremental encoder cable — SVCAB-ENC075CA-***L-05:



End B	Form End A to End B



End A	Type	Color	End B	Signal name
1	AWG 26	Orange (red dotted)	1	VCC
2		Orange (black dotted)	2	GND
3		White (black dotted)	3	
4		White (red dotted)	6	—
5		—	4	-DO
6		Iron shell	Iron shell	SHLELD
7		White (red dotted)	5	+DO

2.10 Safety function signals STO (CN3)

The following describes the name, function and connection example of the safety function signal (CN3).

2.10.1 Names and functions of the safety function signal (CN3)

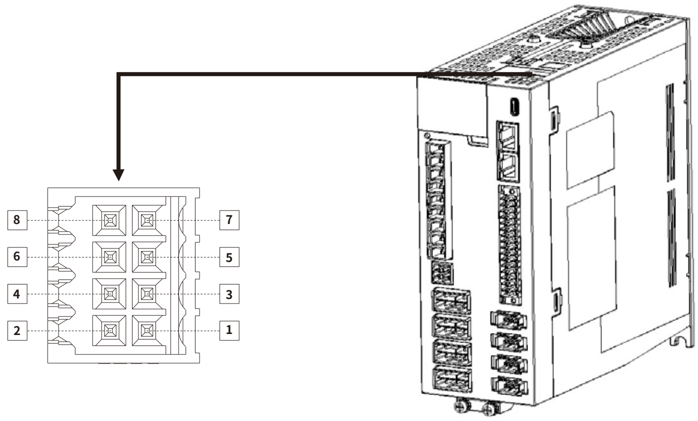


Figure 2-19 Names and functions of the safety function signal (CN3)

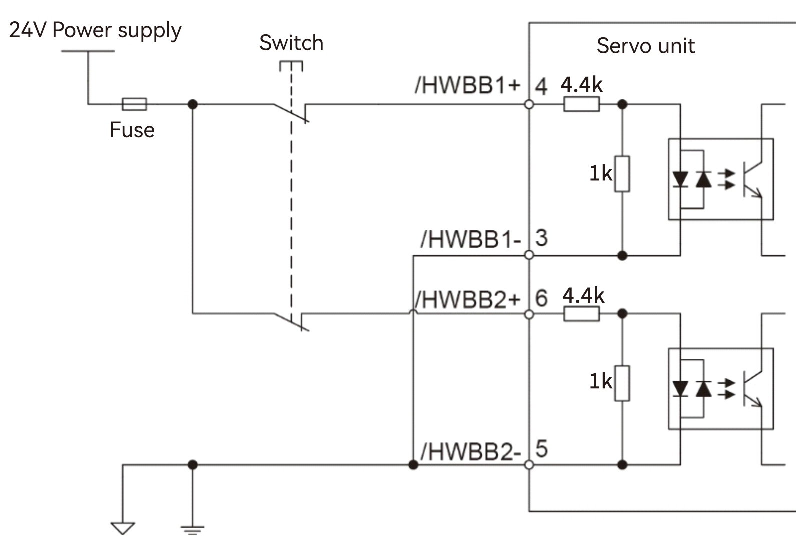
Table 2-24 Name and function list of safety function use signal (CN3)

Signal name	Pin number	Function
—	1	Do not make any connections
—	2	
/HWBB1-	3	For a hard wire base block input. The base block (motor power turned OFF) is in effect when the signal is OFF.
/HWBB1+	4	
/HWBB2-	5	
/HWBB2+	6	
—	7	—
—	8	—

2.10.2 Safety input circuit

Use a 0-V common to connect the safety function signals. You must connect redundant input signals.

Example of input signal connection



2.10.3 Example of Safety Terminal Default Wiring

If the safety terminal (CN3) is to be used, please connect it as illustrated in the following figure:

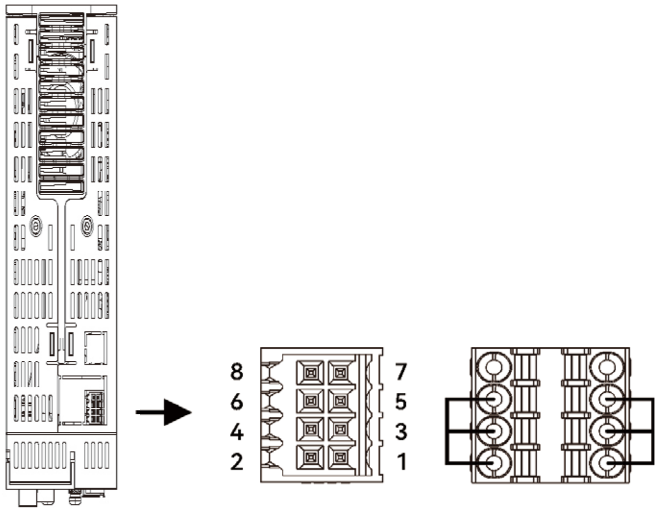


Figure 2-20 Safety terminal wiring

2.11 Communication connector (CN6)

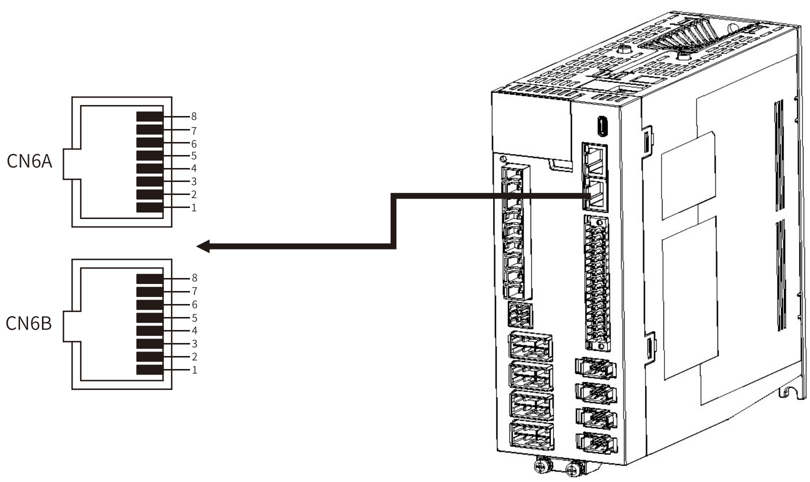


Figure 2-21 CN6 RJ45 Interface pin arrangement

Table 2-25 Name and function of EtherCAT communication connectors

Connector	Signal	Pin (Pin)	Meaning
CN6A (In)	TD+	1	Send data +
	TD-	2	Send data -
	RD+	3	Receive data+
	-	4 and 5	-
	RD-	6	Receive data-
	-	7 and 8	-
CN6B (Out)	TD+	1	Send data +
	TD-	2	Send data -
	RD+	3	Receive data+
	-	4 and 5	-
	RD-	6	Receive data-
	-	7 and 8	-

2.12 Brake input connection (CN10)

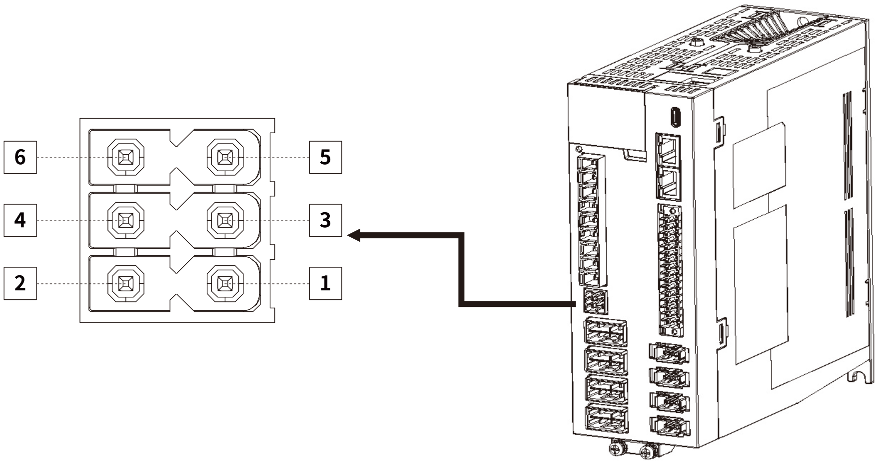


Figure 2-22 CN10 Brake input interface pin arrangement

Table 2-26 Name and function of brake interfaces

Signal name	Pin number	Function
24V	1	Brake external power supply
0V	2	
BKA+	3	Brake A input
BKA-	4	
BKB+	5	Brake B input
BKB-	6	

2.12.1 Brake wiring

The brake is a mechanism that prevents the servo motor shaft from moving when the servo drive is not running, and keeps the motor locked in position, so that the moving parts of the machine will not move due to its own weight or external force.

The connection of the brake input signal has no polarity, please install a separate power supply for the 24-VDC power supply from other power supplies. The standard wiring example of the brake signal BK and the brake power supply is as follows:

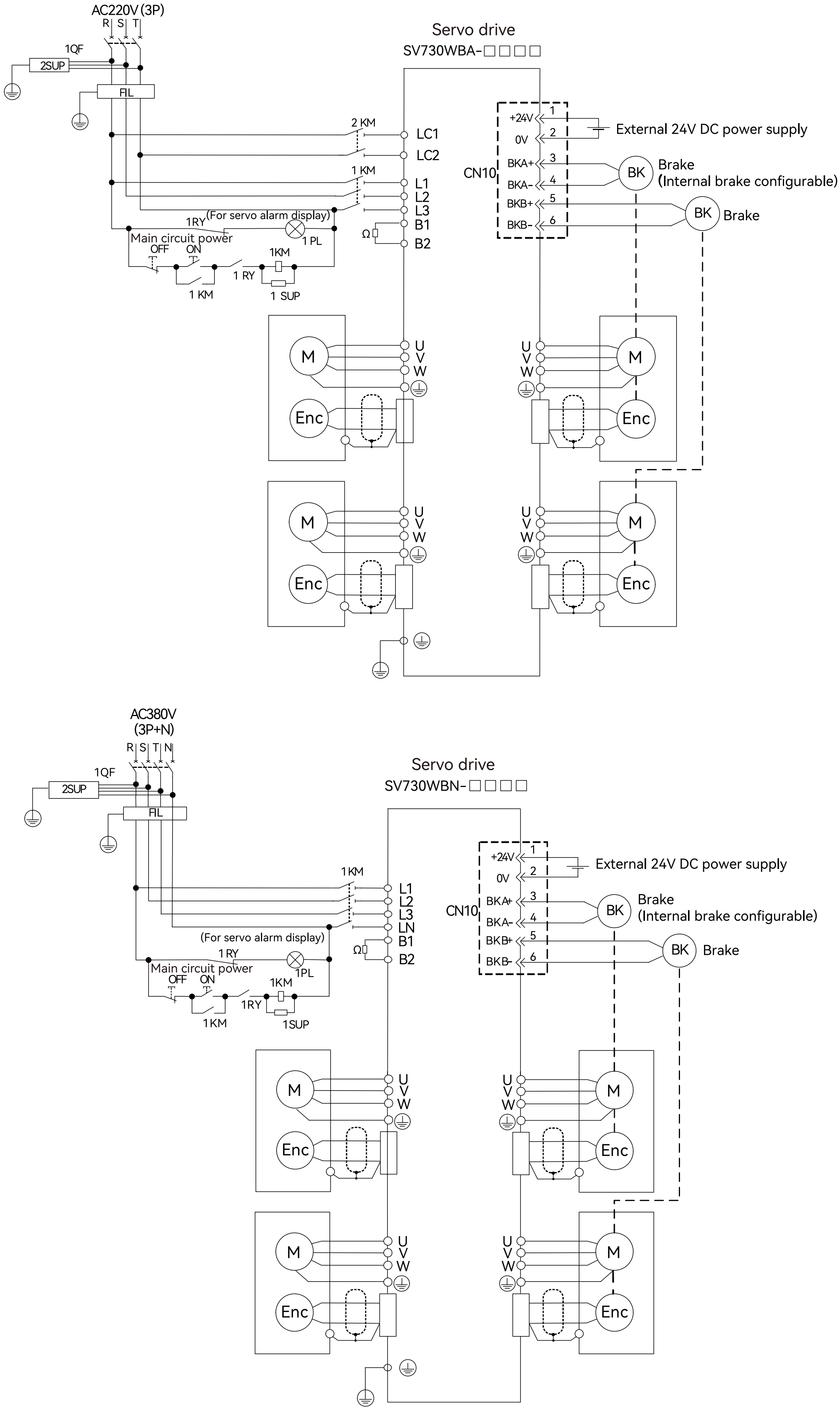


Figure 2-23 SV730W Brake CN10 connection wiring

Note: It is forbidden for the brake to share the power supply with other electrical appliances to prevent the voltage or current from decreasing due to the work of other electrical appliances, which will eventually cause the brake to malfunction.

2.13 Noise and harmonic countermeasures

Noise and harmonic countermeasures

2.13.1 Countermeasures against noise

Note: 1. As the servo unit is designed as an industrial device, no measures provided to prevent radio interference.

2. The Servo unit uses high-speed switching elements in the main circuit. Therefore, external devices may be affected by switching noise. If the equipment is to be used near private houses or if radio interference is a problem, take countermeasures against noise.

This servo unit uses microprocessor. Therefore, there may be noise interference from its externals.

In order to prevent mutual noise interference between the servo unit and its external equipment, take the following countermeasures against noise interference as required.

- Install the input reference device and noise filter as close to the servo unit as possible
- Always install a surge absorber for relays, solenoids, and magnetic contactor coils.
- Do not place the main circuit cables and I/O signal cables/encoder cables in the same duct or bundle them together. Also, separate the cables from each other by at least 30 cm.
- Do not share the power supply with an electric welder or electrical discharge machine. If the servo unit is placed near a high-frequency generator, install Noise Filters on the input side on the main circuit power supply cable and control power supply cable even if the same power supply is not Common with the high-frequency generator. For the connection method of the noise filter, refer to "(1) Noise filter".
- Please implement suitable grounding measures, refer to "(2) Grounding".

I. Noise filter

Connect the noise filter to an appropriate place to avoid adverse effects of noise on the servo unit.

The following is an example of wiring for countermeasures against noise.

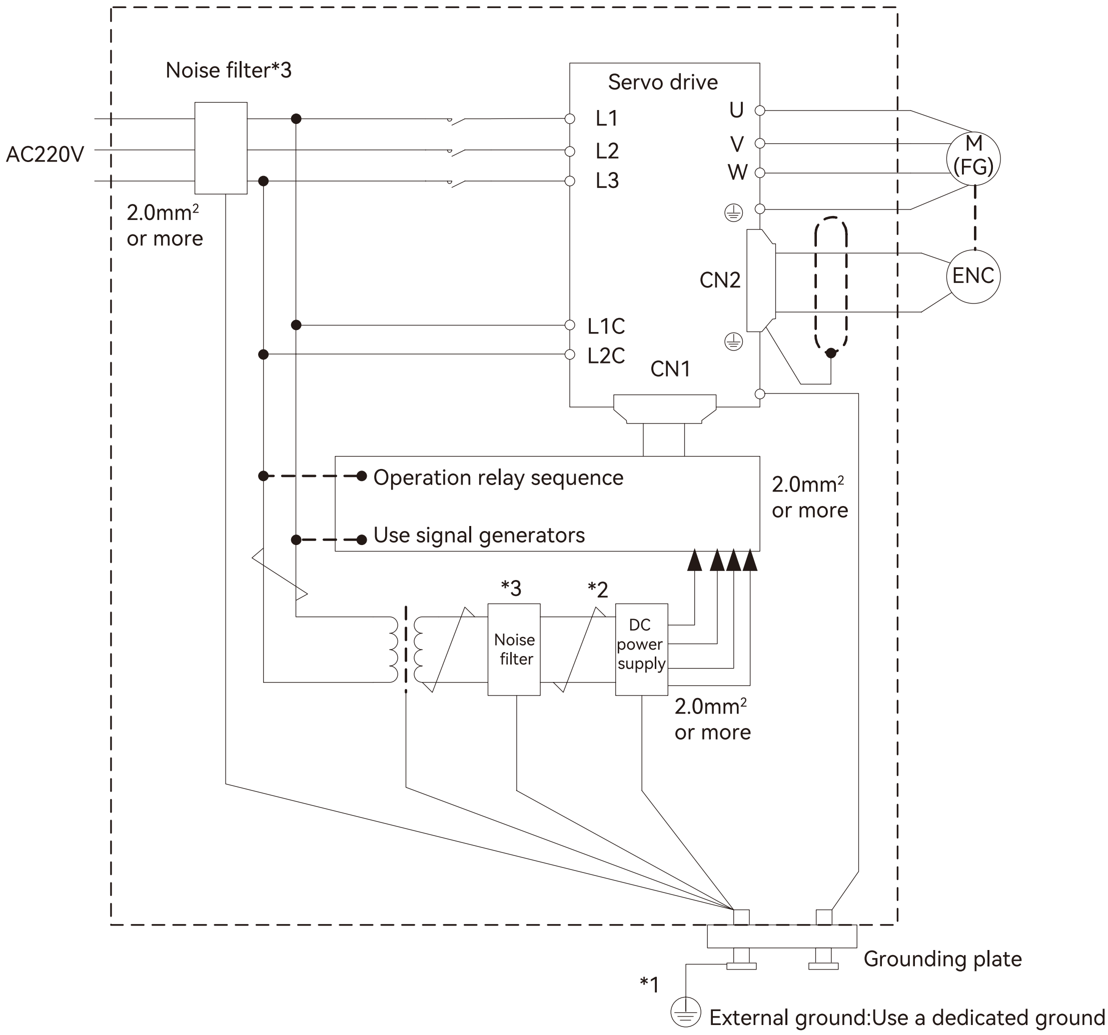


Figure 2-24 Wiring example of noise countermeasure

Note: * 1. For the ground wire, use a wire with a thickness of at least 2.0 mm2 (preferably, flat braided copper wire).

* 2. Please use twisted-pair wires for wiring

* 3. Regarding the use of noise filters, please observe the precautions in 2.13.1 "Noise and its countermeasures"

(二). Grounding

In order to prevent malfunction due to the influence of noise, the proper grounding method is as below.

Motor Frame Ground

If you ground the servo motor through the machine, switching noise current can flow from the main circuit of the servo unit through the stray capacitance of the servo motor. To prevent this, always connect the FG terminal of the servo motor main circuit cable connected to the servo motor to the ground terminal on the servo unit. Also be sure to ground the ground terminal on servo unit.

Noise on I/O Signal Cables

Implement one-point grounding on the 0V line (SG) of the I/O signal cable . When the main circuit cable of the servo motor is covered with a metal sleeve, be sure to ground at one point for the metal sleeve and the junction box.

2.13.2 Noise filter wiring and connection precautions

I. Noise filter for brake power supply

Use a noise filter for the brake power input for a servo motor of 400W or less with brake.

II. Precautions for noise filter installation and wiring

Please observe the following precautions when installing and wiring the noise filter.

Note: Depending on the model, some noise filters have a large leakage current. In addition, due to the different grounding conditions, the leakage current will also change greatly. Please consider the grounding conditions and the leakage current of the filter, etc., and choose to use leakage detectors and leakage circuit breakers. For details, please consult the filter manufacturer.

Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.

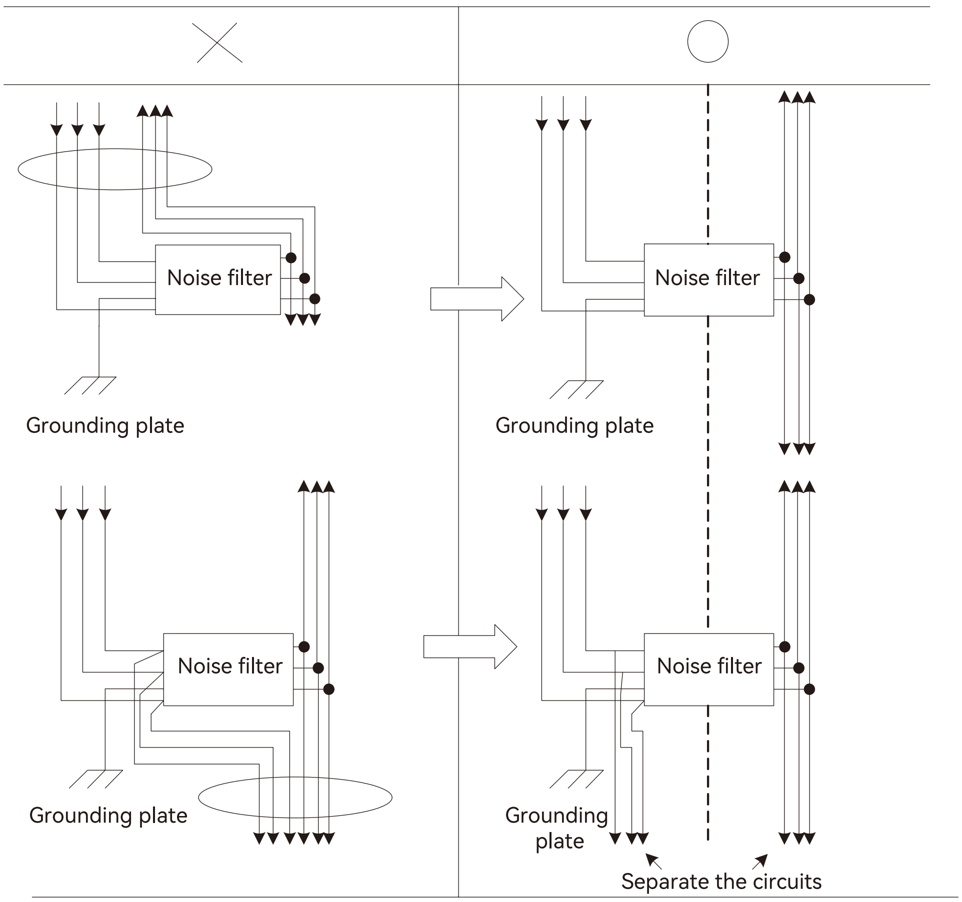


Figure 2-25 Noise filter wiring

Separate the noise filter ground wire from the output lines. Do not place the noise filter ground wire, output lines, and other signal lines in the same duct or bundle them together.

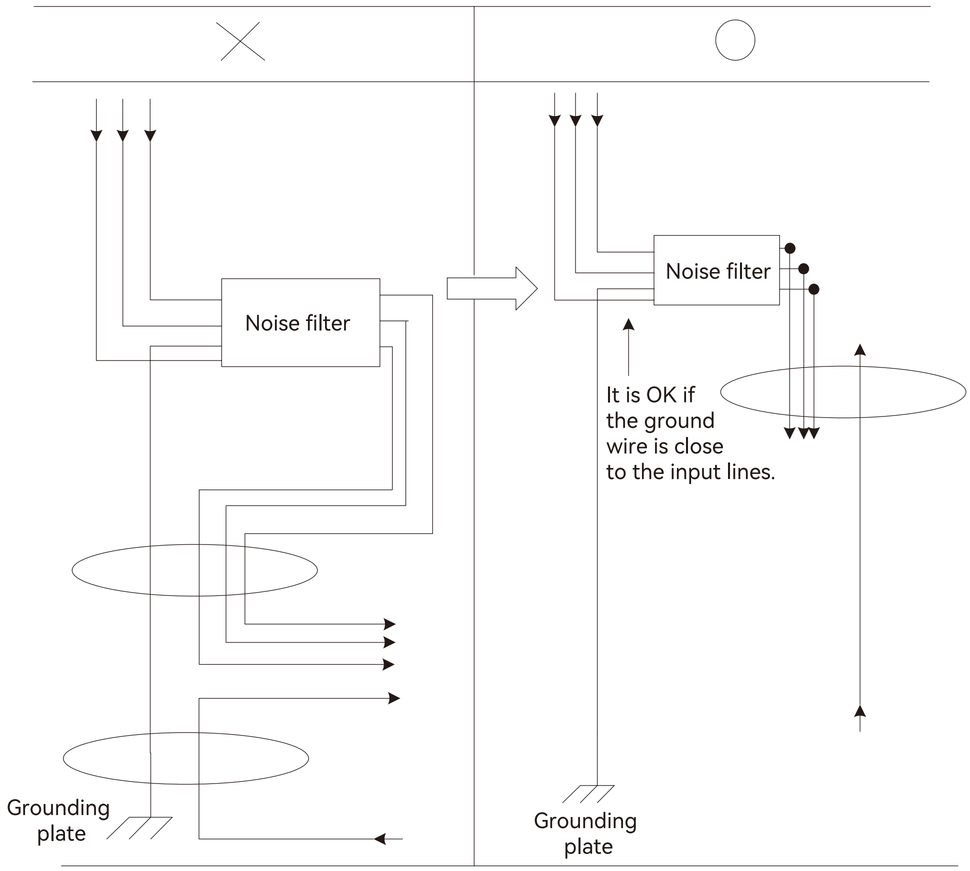


Figure 2-26 Noise filter grounding

Connect the ground wire of the noise filter to the grounding plate separately. Do not connect other ground wires.

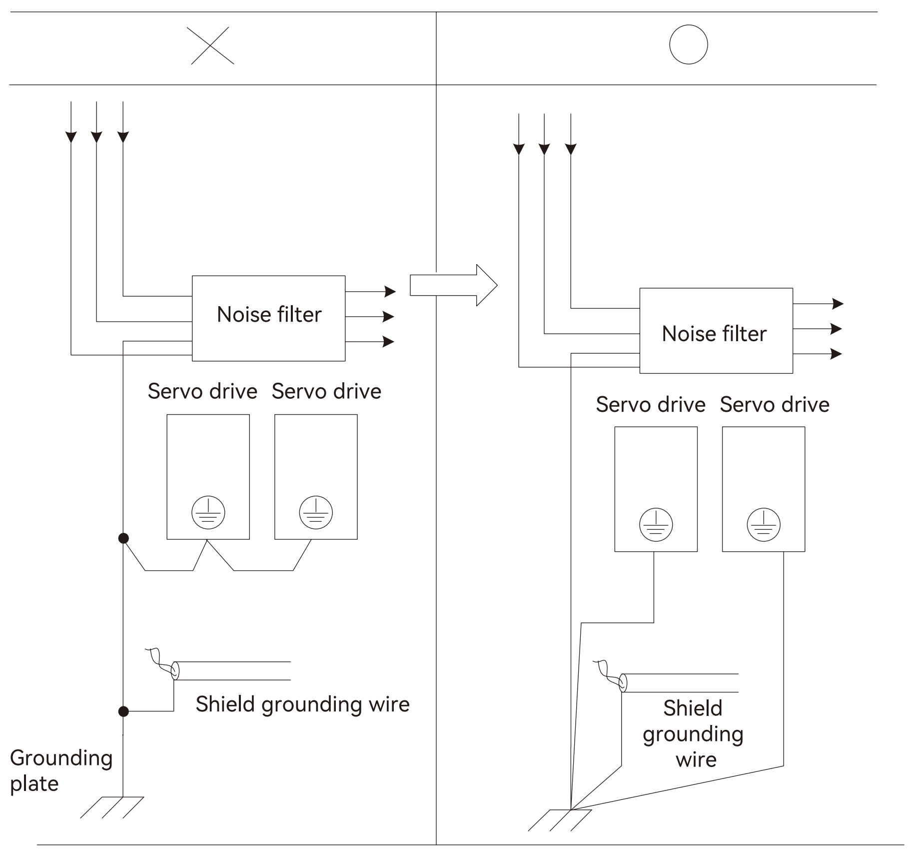


Figure 2-27 Noise filter grounding

If a noise filter is located inside a control panel, first connect the Noise Filter ground wire and the ground wires from other devices inside the control panel to the grounding plate for the control panel, then ground the plate.

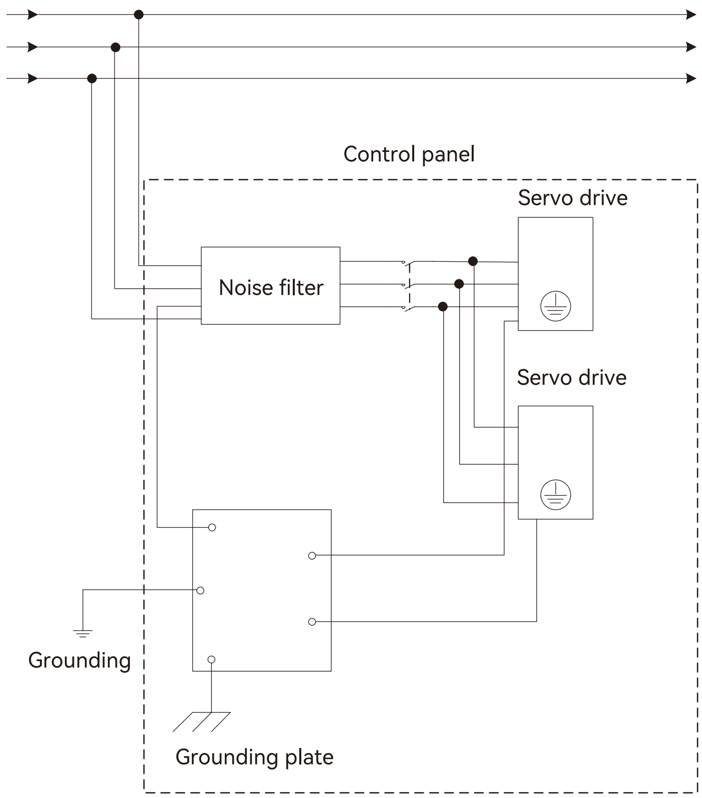
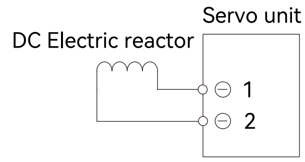


Figure 2-28 Noise filter and control panel grounding

2.13.3 Connection of reactor for harmonic suppression

When it is necessary to take countermeasures against high-order harmonics, a reactor for suppressing high-order harmonics can be connected to the servo unit.

Example of input signal connection


Note: * 1. Connection terminals 1 and 2 for a DC Reactor are connected when the servo unit is shipped. Remove the lead wire and connect a DC Reactor.

* 2. The reactor is optional (need to be equipped separately).

Chapter 3 EtherCAT Communication Introduction

3.1 EtherCAT communication protocol introduction

EtherCAT is a high-speed real-time Ethernet technology developed by Beckhoff in Germany. Its features include low hardware cost, simple and convenient application, simple network topology, and uses standard Ethernet physics. It can be used for high-speed IO interconnection and data interaction in industrial sites. Its basic communication mode is master-slave communication, single master and multi-slave communication. The master station can be realized by the ordinary network card of the computer or a dedicated master station PLC, and the slave station is generally composed of ET1100 provided by Beckhoff or an authorized third-party integrated slave station ASIC.

Basic features:

I. High speed:

Precise synchronization is achieved by distributed clocks

II. Fast data refresh:

30 μs processing 1000 digital I/Os

100μs processing 100 servo axes

III. High efficiency, maximizing the use of Ethernet bandwidth for user data transmission

IV. Good synchronization performance, each node slave device can achieve a synchronization accuracy of less than 1us

3.2 Definition of communication network interface

Definition of Communication Network Interface is shown in the table below:

Table 3-1 EtherCAT communication network interface definition

CiA402 control mode	Supported or not
Cyclic synchronous position (CSP)	Supported
Cyclic synchronous velocity (CSV)	Supported
Cyclic synchronous torque (CST)	Supported
Proifile position mode (PP)	Supported
Profile velocity mode (PV)	Supported
Profile torque mode (PT)	Supported
Home mode (HM)	Supported

3.3 Parallel networking of multiple servos

EtherCAT servo drive:

When multiple EtherCAT servo drives are networked, the network cables must be inserted in strict accordance with the order of the top-in and bottom-out network ports (note that no terminal resistors are added). As for whether to set the servo station number, it is determined by the host controller.

The EtherCAT servo drive supports a fixed communication rate of 100M bit/s, and the maximum communication length between 2 stations is 100 meters.

Note: 1. The bus servo drive network cable should be separated from other cables when routing in the electric cabinet, especially the strong current line, and should be kept away from interference sources (such as transformers, frequency converters, cabinet fans, etc.) as much as possible.

2. The network cable of the bus servo driver should be twisted-pair network cable to improve the resistance to high-frequency magnetic field noise interference and reduce the external radiation of the cable.

3. Bus servo drive grounding is separated from other grounding as much as possible, separate grounding treatment.

3.4 EtherCAT frame structure

3.4.1 Control modes supported by EtherCAT

The 730W drive EtherCAT is based on the CANOpen application layer profile CiA402 servo and motion control profile. Support the following modes of CiA 402, which is shown in the table below.

Table 3-2 Table 29. CiA402 mode supported by EtherCAT servo drives

CiA402 control mode	Supported or not
Cyclic synchronous position (CSP)	Supported
Cyclic synchronous velocity (CSV)	Supported
Cyclic synchronous torque (CST)	Supported
Proifile position mode (PP)	Supported
Profile velocity mode (PV)	Supported
Profile torque mode (PT)	Supported
Home mode (HM)	Supported

3.4.2 EtherCAT frame structure

The frame structure of EtherCAT consists of EtherCAT frame header + more than one EtherCAT sub-message + frame check sequence (FCS), as shown in the figure below:

14byte	46~1500byte	4byte
EtherCAT Header	EtherCAT Date	FCS

Figure 3-1 EtherCAT frame structure

3.4.3 EtherCAT state machine

The EtherCAT slave device requires the above four basic states to facilitate data interaction between the master and the slave to manage the state machine of the slave application. It is shown in the figure below:

- Init (I): Initialization state
- Pre-Operational (P): Pre-operational state
- Safe-Operational (S): Safe operational state
- Operational (O): Opeational state

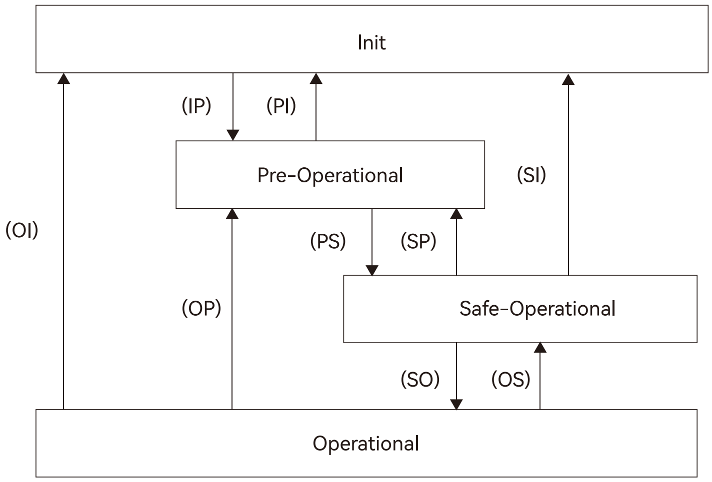


Figure 3-2 EtherCAT state machine

The initialization of the slave station to the operational state follows the rule of switching from the pre-operational state, then the safe operational state, and then to the operational state. The operational state can be directly switched back to other various state.

EtherCAT status transition operations are shown in the table below:

Table 3-3 EtherCAT state transition

State transition	Operation
(Init)	Yes
Init To Pre-OP(IP)	Yes
(Pre-OP)	Yes
Pre-OP To Safe- OP(PS)	Yes
(Safe-OP)	Yes
Safe-OP To Op(SO)	Yes
(Op)	Yes

A brief introduction is shown in the table below:

Table 3-4 EtherCAT states profile

States	Communication operation			Description
	SDO	TxPDO	RxPDO	
Initialization (I)	NO	NO	NO	Communication initialization; There is no communication in the application layer, the master station can only read and write the ESC register
IP	NO	NO	NO	The master station configures the slave station address; Configures the mailbox channel; Configures the DC distributed clock; Requests the "Pre-Operational" state
Pre-Operational (P)	YES	NO	NO	Application layer mailbox data communication (SDO)
PS	YES	NO	NO	The master station uses SDO to initialize the process data mapping; The master station configures the SM channel used for process data communication; The master station configures FMMU; Request " Safe-Operational" staes
Safe-Operational (S)	YES	NO	YES	SDO and TxPDO can be used, distributed clock mode can be used

SO	YES	NO	YES	Master sends output data to request "Operational" states
Operational (O)	YES	YES	YES	Normal operating state; All inputs and outputs are enabled; Email communication is still available

3.4.4 Process data PDO

Periodic process data is used for periodic control data interaction between the master station and the slave station. The servo drive uses the SM2 (0x1C12) channel to map RxPDO data, and uses the SM3 (0x1C13) channel to map TxPDO data.

The servo driver supports one slave station, and each slave station supports 4 slots. Each slot is configured with one group of PDO. In each PDO group, RxPDO and TxPDO support a maximum of 12 mapping objects each. Among them, TxPDO1 and RxPDO1 support remapping. It is shown in the table below.

Table 3-5 EtherCAT default PDO mapping configuration

RxPDO	Mapping object	RxPDO Configuration
1600h (RxPDO1) (13Byte)	Control word (6040h)	60400010
	Control mode (6060h)	60600008
	Target position (607Ah)	607A0020
	Touch probe function (60B8h)	60B80010
	Target velocity (60FFh)	607A0020
1610h (RxPDO2) (13Byte)	Control word (6840h)	68400010
	Control mode (6860h)	68600008
	Target position (687Ah)	687A0020
	Touch probe function (68B8h)	68B80010
	Target velocity (68FFh)	68FF0020
1620h (RxPDO3) (13Byte)	Control word (7040h)	70400010
	Control mode (7060h)	70600008
	Target position (707Ah)	707A0020
	Touch probe function (70B8h)	70B80010
	Target velocity (70FFh)	707A0020
1630h (RxPDO4) (13Byte)	Control word (7840h)	78400010
	Control mode (7860h)	78600008
	Target position (787Ah)	787A0020
	Touch probe function (78B8h)	78B80010
	Target velocity (78FFh)	787A0020

TxPDO	Mapping object	TxPDO Configuration
1A00h (TxPDO2) (31Byte)	Error code(603Fh)	603F0010
	Status word (6041h)	60410010
	Control mode display (6061h)	60610008
	Position feedback (6064h)	60640020
	Velocity value feedback (606Ch)	606C0020
	Touch probe status (60B9h)	60B90010
	Touch probe 1 rising edge position feedback (60BAh)	60BA0020
	Touch probe 2 rising edge position feedback (60BCh)	60BC0020
	Position offset value (60F4h)	60F40020
	DI status (60FDh)	60FD0020

TxPDO	Mapping object	TxPDO Configuration
1A10h (TxPDO2) (31Byte)	Error code (683Fh)	683F0010
	Status word (6841h)	68410010
	Control mode display (6861h)	68610008
	Position feedback (6864h)	68640020
	Velocity value feedback (686Ch)	686C0020
	Touch probe status (68B9h)	68B90010
	Touch probe 1 rising edge position feedback (68BAh)	68BA0020
	Touch probe 2 rising edge position feedback (68BCh)	68BC0020
	Position offset value (68F4h)	68F40020
	DI status (68FDh)	68FD0020
1A20h (TxPDO3) (31Byte)	Error code (703Fh)	703F0010
	Status word (7041h)	70410010
	Control mode display (7061h)	70610008
	Position feedback (7064h)	70640020
	Velocity value feedback (706Ch)	706C0020
	Touch probe status (70B9h)	70B90010
	Touch probe 1 rising edge position feedback (70BAh)	70BA0020
	Touch probe 2 rising edge position feedback (70BCh)	70BC0020
	Position offset value (70F4h)	70F40020
	DI status (70FDh)	70FD0020
1A30h (TxPDO4) (31Byte)	Error code (783Fh)	783F0010
	Status word (7841h)	78410010
	Control mode display (7861h)	78610008
	Position feedback (7864h)	78640020
	Velocity value feedback (786Ch)	786C0020
	Touch probe status (78B9h)	78B90010
	Touch probe 1 rising edge position feedback (78BAh)	78BA0020
	Touch probe 2 rising edge position feedback (78BCh)	78BC0020
	Position offset value (78F4h)	78F40020
	DI status (78FDh)	78FD0020

I. Synchronously manage PDO configuration

In 730W , each axis supports only one fixed RxPDO and one fixed TxPDO configuration. As shown in the table below.

Table 3-6 PDO supported by EtherCAT servo drive

Index	Subindex	Mapping object
0x1C12	0	Each axis is assigned a fixed RxPDO from the range 1600 to 1630.
0x1C13	0	Each axis is assigned a fixed TxPDO from the range 1A00 to 1A30.

II. PDO mapping management

The PDO mapping content contains the information that needs to receive or send PDO, including index, sub-index and data length. Its sub-index 0 indicates the number of PDO mapping objects, and sub-indexes 1 to n represent the content represented by the first to n elements of the PDO. Each PDO mapping object can map a data object containing 4 bytes at most, and one PDO can contain up to 4*n data lengths.

The mapping content consists of 2 bytes representing the index of the object, one byte representing the sub-index, and one byte representing the data length, as shown in the table below:

Table 3-7 Mapping content structure

Bytes	Bytes 3~2	Bytes 1	Bytes 0
Meaning	Index	Subindex	Data length

The index and sub-indexes determine the positional information of the object in the object dictionary, and the data length indicates how many bits make up the object. The length information generally has byte (8bit), word (16bit), double word (32bit) three types, specific by the actual length of the object which consists of a hexadecimal string.

For example: an object mapping content of 60400010h means that the index of the object is 0x6040, the sub-index is 0x00, the length of 16bit that is a word.

3.4.5 Mailbox data SDO

SDO parameters are CoE-defined non-periodic data communication, and the master realizes non-periodic data interaction through the read/write mailbox data SM channel.730W drives can modify drive parameters through SDO.

3.4.6 Distributed clock

The Distributed Clock (DC, Distributed Clock, 64bit) allows all EtherCAT settings to have the same system time, thus controlling the synchronized execution of the tasks of the devices. The slave devices can be used to trigger synchronous updates of the slave data at the same time, based on the synchronization signals generated by the synchronized system clock. the Y7S drive supports the synchronized clock mode, which currently supports the synchronization signals generated by SYNC0 and Free Run.

3.4.7 CiA402 control process introduction

The state machine related to the power control of the servo drive is shown in the figure below. The power status of each phase of the PDS state machine is shown in the table below.

Table 3-8 PDS state machine power status in different phase

PDS Phase	Control power	Power supply	Drive status
Phase 1	OK	NO	NO
Phase 2	OK	OK	NO
Phase 3	OK	OK	OK

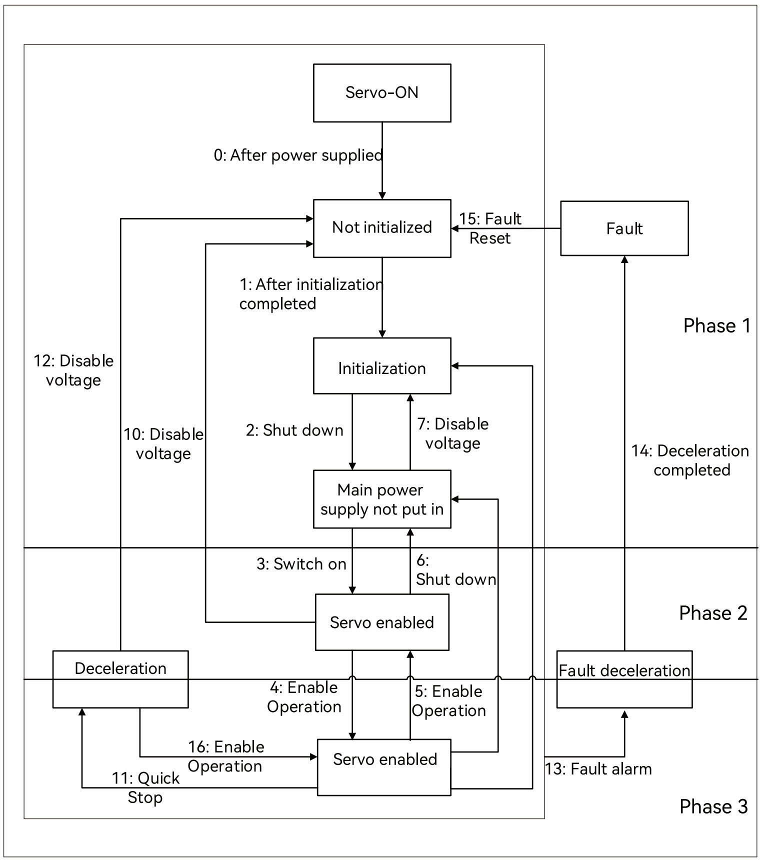


Figure 3-3 CiA402 control process state machine

3.4.8 ESI Documents

The ESI file (.XML file) contains information about the 730W Servo Drive's EtherCAT slave, and the master generates an ENI based on the ESI to form an EtherCAT network, so the ESI file (.XML file) provided by our company needs to be saved in a folder specified by the master for normal communication. Therefore, the ESI file (.XML form) provided by our company should be saved in the folder specified by the master in order to communicate properly.

Chapter 4 Commissioning and Operation

4.1 Checks and precautions before test run

To ensure safe and correct test run, check and confirm the following items in advance.

I. Servo motor inspection

Check and confirm the following items for the servo motor—address any issues

- Check whether the settings and wiring are correct.
- Check whether fasteners are loose.

Note: For motors with oil seals: Check whether the oil seal is damaged; Check whether oil has been applied. For long-stored servo motors, follow the manufacturer's maintenance and inspection guidelines during test run.

II. Servo drive status inspection

Check and confirm the following items for the servo drive—address any issues properly before test run:

- Check whether the settings and wiring are correct.
- Check whether the power supply voltage to the servo drive is normal.

4.2 Single-servo motor test run

Please refer to Auxiliary function Fn002 in Chapter 8 for trial operation of Servo motor.

4.3 Origin search and positioning (Fn003)

Origin search is a function that determines the position of the origin pulse (C-phase) of the incremental encoder and stops the motor at that position. This function is used when positioning the motor shaft and mechanical components is required.

Origin search can be executed under the following conditions:

- S-ON input is not present.

Motor speed during execution is 60 rpm.

Points	• Perform origin search with the coupling unconnected. • During origin search, forward drive prohibition (P-OT) and reverse drive prohibition (N-OT) are disabled.

Please refer to Auxiliary function Fn003 in Chapter 8 for the operation.

4.4 Single servo motor test run via host device commands

When performing a single servo motor test run via host device commands, confirm the following items:

- Confirm that the servo motor movement commands and input/output signals from the host device to the servo drive are correctly set.
- Confirm that the wiring between the host device and the servo drive is correct.
- Confirm that the operation settings of the servo drive are correct.

DANGER ⚠

・When performing a single servo motor test run via host device commands, to prevent accidents, conduct the test with the servo motor unloaded (single-unit state with couplings, belts, etc., disconnected).

4.4.1 Input signals connection and parameter modification

Connect the input signal circuits required for the test run to the input/output signal port (CN1). The following conditions apply during connection.

Modify the following parameters:

① No parameter changes are needed for absolute encoders. For incremental encoders, set "Pn002.2=1".

② For single-phase power input, set "Pn00B.2=1".

4.5 Test run after connecting servo motor to machinery

The following describes the test run method after connecting the servo motor to the machinery. This example assumes the single-servo motor test run is complete.

CAUTION ⚠

・When performing a single servo motor test run via host device commands, to prevent accidents, conduct the test with the servo motor unloaded (single-unit state with couplings, belts, etc., disconnected).

Points

・During the single-servo motor test run, overtravel signals (P-OT, N-OT) are set to OFF. Set them to ON now to activate protection functions.

Table 4-1 Test run steps

Step	Operation	Reference
1	Connect the control power supply and main circuit power supply. Set up protective functions related to safety functions, overtravel, brakes, etc. ・When using a servo motor with a brake, before confirming the brake's operation, first take measures to prevent the machinery from falling naturally or vibrating due to external forces. Then confirm that the servo motor and the brake operate normally.	"5.4.3 Setting of Overtravel" "5.4.4 Brakes "
2	With the power in the OFF state, connect the servo motor and the machinery using couplings or similar means.	—
3	After confirming the servo drive is in servo - OFF status, turn on the power supply of the machinery (host device). Then recheck whether the protective functions set in step 1 operate normally. (Note) To avoid abnormalities during subsequent operations, keep the equipment in a state where it can be emergency-stopped.	"5.4.5 How to stop the motor when the servo is OFF and an alarm occurs
4	Recheck that the parameter settings match each control mode. Then confirm if the servo motor's operation meets the mechanical operation specifications.	—
5	Adjust the servo gain as required to improve the response characteristics of the servo motor. During test runs, there may be a mismatch between the servo motor and the machinery; ensure sufficient break-in operation is done.	"Chapter 7 Tuning"

4.6 Test run of brake-equipped servo motor

Follow these precautions for test runs of brake-equipped servo motors:

・ Before confirming brake operation, take measures to prevent the machinery from falling naturally or vibrating due to external forces.

・ First, confirm the operation of the servo motor and brake in the separated state (servo motor disconnected from machinery). If no issues arise, reconnect the servo motor and repeat the test run.

Use the servo drive's brake interlock output (/BK) signal to control the brake operation of the brake-equipped servo motor. Please refer to " 5.4.4 Brake " for wiring and related parameter setting.

Chapter 5 Basic Function of Servo

5.1 Precaution

Table 5-1 Signal table

Name	Function
⚠ DANGER	Indicates that may cause death or serious injury
⚠ CAUTION	Indicates that may cause injury or property damage

5.2 Panel operation procedures and display

The user can confirm the servo status through the panel display of the servo unit.

modify and monitor the Utility function (Fn □□□), parameter setting (Pn □□□) and monitoring function (Un □□□) through the operator keys. Also, when an alarm or warning occurs, the corresponding alarm/warning number is displayed.

5.2.1 Panel operator keys

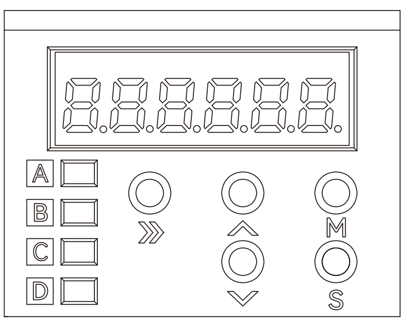


Figure 5-1 Panel buttons

Key number	Key name	Function
»	Axis switch key	After switching axes, you can perform basic mode operations on the corresponding axis
Λ	UP	(1) Increase the set value. (2) It is used as the forward rotation start key when JOG is running in the Auxiliary function mode.
V	DOWN	(1) Decrease the setting value. (2) It is used as the reverse start key when the JOG is running in the Auxiliary function mode.
M	MODE (Mode and confirmation key)	(1) Switch the basic mode: Utility function, parameter setting, monitoring function. (2) Confirm the set value: After modifying the parameters, short press the key to confirm the set value. The effect is consistent with the SET key.
S	SET	(1) Long press this key for more than 1 s to display the set value of each parameter. (2) After modifying the parameters, press and hold this key for more than 1 s to confirm the set value. (3) Short press this key to move the digit to the left by one digit (when the digit is flashing). If the data length exceeds the four digits displayed on the panel, press it four times to switch the panel display to the middle four digits, and then press four times to switch to the top two.

Status light	Meaning
Off	Current axis disabled
Solid white	Current axis enabled
Solid yellow	Current axis warning occurred
Flashing yellow	Current axis alarm occurred

5.2.2 Changing modes

Table 5-2 Modes switching table

Function	MODE key	Long press the SET key
Initial status	A.10rdy	—
Auxiliary function	A.Fn000	A.0. 9b3
Parameter setting	A.Pn000	A.n.0000
Monitoring function	A.Un000	A.n. 000

Note: Press the MODE key to switch modes, it will cycle from top to bottom according to the table

5.2.3 Status display and judgment

After the power is turned on, the normal state display is shown in figure below. The first data bit is used for EtherCAT communication status display. The second data bit is used for judging signal status, and the short codes are for motor status.

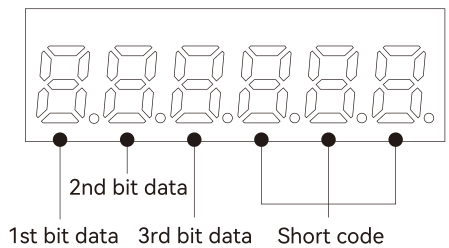


Table 5-3 Data bit interpreting table

Serial number	Display	Control mode	Meaning
First data bit display	A88888	—	Currently displayed axis number is A axis
	b88888	—	Currently displayed axis number is B axis
	C88888	—	—
	d88888	—	—
Second data bit display	818888	—	Initialization status
	828888	—	Pre-operation status
	848888	—	Safe running status
	888888	—	Running status

Third data bit display	0	No mode	—
	1	Profile position mode	—
	3	Profile speed mode	—
	4	Profile torque mode	—
	6	Homing mode	—
	8	Cyclic synchronous position mode	—
	9	Cyclic synchronous speed mode	—
	A	Cyclic synchronous torque mode	—

Table 5-4 Code interpreting table

Display	Meaning
rdy	Base block active Indicates the servo is OFF.
run	Operation in progress Indicates the servo is ON.
Not	Reverse drive prohibited Indicates that the N-OT (reverse drive prohibit) signal is open.
Pot	Forward drive prohibited Indicates that the P-OT (forward drive prohibit) signal is open.
ot	Forward/reverse drive prohibited status Positive and negative limit signals input simultaneously
Sto	Security function Indicates the safety function is activated and the servo is in the hardware base block status.
FSt	Emergency stop function Servo is in emergency stop status
C90	Alarm log Indicates the alarm number.

5.2.4 Operation of auxiliary function (Fn□□□)

The auxiliary function is used for the functional operation of the servo unit, take the origin search " Fn003 " operation as an example.

① Press ≫ key to switch to the desired axis number.

② Press M key to switch to utility mode "Fn000" is displayed.

③ Press ∧ or ∨ key to select to "Fn003".

④ Press S after pressing the key for 1 second, Fn003 is displayed (origin search) execution screen "-.CSR", the duration is about 1 second.

⑤ First press M key to enable the servo , and then press and hold ∧ (the motor rotates forward) or ∨ (motor reverse rotation) to search for the origin, the search direction of the servo motor rotation origin changes according to the setting of Pn000.0 . Keep pressing ∧ (motor forward) or ∨ (motor reverse) key until the servo motor stops, and the panel displays " .CSR ", at this time, the motor searches for the origin.

⑤ After the origin search is completed, press (M) key to disable the motor , and the panel displays " - .CSR " .

⑥ After pressing (S) key for 1 second, return to the utility function menu " Fn003 " (origin search function).

5.2.5 Parameter setting (Pn□□□)

There are two types of parameter setting for Pn □□□ .

The first type "Numerical setting type": Set a specific value.

The second type "Function selection type": Select the application function.

The setting methods of "Numerical setting type"and "Function selection type"are introduced respectively below.

Note: When the panel displays incomplete parameters, please modify the parameter "Pn00B.0" to "1: Display all parameters".

In the default setting, only the parameters for setting are displayed, and the parameters for adjustment are not displayed. To display all parameters, please set Pn00B =n. □□□ 1 (display all parameters).

Table 5-5 Pn00B =n. □□□ 1 parameter settings

Parameter		Meaning	When enabled	Classification
Pn00B (Function selection application switch B)	n. □□□ 0	Only parameters for setting are displayed	After restart	Setup
	n. □□□ 1 (Default value)	Show all parameters		

5.2.6 Numeric settings

Take the electronic gear ratio (numerator): " Pn78C " changed to 8388608 as an example.

① Press (>>) key to switch to the desired axis number.

② Press (M) key to switch to parameter setting mode " Pn000 " is displayed.

③ Press (S) after selecting the digit to be changed, press (∧) or (∨) key to select " Pn78C ".

④ Press and hold (S) key for about 1 second, and the current setting value of "Pn20E" shown on the screen will be displayed" _0001 ".

⑤ Press (S) key to move the flashing digit left and right, and then press (∧) or (∨) key to set the last four digits 8608 , and the panel displays " _8608 ".

⑥ Press (S) key to move the flashing number to the leftmost, and press (S) key again to switch to the first four-digit setting page, and the panel displays " -0000 ".

⑦ Press (S) key to move the flashing digit left and right, and then press (∧) or (∨) key, set the first four digits to 0838 , the panel will display " -0838 ".

⑧ So far Pn20E is the first four digits + last four digits = 08388608 .

⑨ After pressing (S) key for about 1 second, the set value is confirmed. Return to parameter setting" Pn78C "(electronic gear ratio numerator) panel, the value on the panel flashes three times quickly.

Note: 1. When the last four digits are selected, the first data bit d is on, and when the middle four digits are selected, the first data bit g is on.

2. When the first two digits are selected, the first data bit a lights up. If you want to set more than four digits, the method is the same.

5.2.7 Selecting functions

Take the function selection basic switch 0: " Pn000 " as an example to select " Pn000.1 " as the control mode to change from speed control to position control.

① Press key to switch to the desired axis number.

② Press M key to switch to parameter setting mode " Pn000 " is displayed.

③ Press and hold S key to display the original set value of "Pn000" shown on the screen , and the panel displays " n0000 " .

④ Press S key for once to move the digit to the left by one (flashing) to select Pn000.1 , and the panel displays " n0000 ".

⑤ Press or key to change the setting value to "N.0010" , and the panel display is " n0010 ".

⑥ After pressing S key for about 1 second, the set value is confirmed.

Return to the Pn000 menu, the panel is set to " Pn000 " and the value on the panel flashes three times quickly.

⑦ In order to make the setting effective, please reconnect the power supply of the servo unit.

5.2.8 Operation of monitor display (Un☐☐☐)

The monitoring display is used to monitor the status of the servo unit, take the "Un000 " motor speed monitoring operation as an example.

① Press key to switch to the desired axis number.

② Press M key to switch to utility mode " Un000 " is displayed.

③ Press and hold S key for 1 second, the current motor speed will be displayed " 0000 " (display 0000 means the speed is 0).

④ Press and hold S key for about 1 second , return to " Un000 "menu.

5.3 Automatic detection of connected motor

When the servo unit is connected to a standard rotating motor, it will automatically determine which type of servo motor connected. Therefore, you normally do not need to specify the servo motor type.

5.4 Basic function settings

5.4.1 Power settings

I. AC/DC power input setting

The servo unit supports AC/DC power input, which can be set by parameter Pn001 = n. ☐ X ☐☐ .

Table 5-6 Pn001 =n. ☐ X ☐☐ parameter setting table

Parameter		Meaning	When enabled	Classification
Pn001 (Function select application switch 1)	n. ☐ 0 ☐☐ (Default value)	Use an AC power supply input:input AC power from L1, L2, L3 terminals	After restart	Setup
	n. ☐ 1 ☐☐	Use a DC power supply input.: directly input DC power from B1 to N or input DC power from P, N		

Note: 1. When the set value is Pn001 = n. □ X □□ , if it is inconsistent with the actual power input specifications, A.330 (main circuit power supply wiring error) will occur.

2. Please connect the AC power supply to the L1/L2/L3 terminals and LC1/LC2 terminals of the servo unit.

3. Please connect the DC power supply to the B1 (P) terminal and N (N1) terminal of the servo unit, and connect LC1/LC2 to the AC power supply. Otherwise may result in malfunction or fire.

4. Always specify a DC power supply input (Pn001 = n. □ 1 □□) before you input DC power for the main circuit power supply.

If you input DC power without specifying a DC power supply input (i.e., without setting Pn001 to n. □ 1 □ □), the servo unit's internal elements may burn and may cause fire or damage to the equipment.

5. With a DC power supply input, time is required to discharge electricity after the main power supply is turned OFF. A high residual voltage may remain in the servo unit after the power supply is turned OFF. Be careful not to get an electric shock.

6. When DC power is input, please install a fuse on the power supply line.

7. The servo motor returns regenerative energy to the power supply. If you use a servo unit with a DC power supply input, regenerative energy is not processed. Process the regenerative energy at the power supply.

8. When using the SV730W series with DC power input, connect an inrush current prevention circuit externally and implement standard power ON/OFF sequence control.

II. Single-phase/three-phase AC power input setting

Servo drive units support single-phase AC power input, which can be set by parameter Pn00B = n. □ X □□ .

Table 5-7 Pn00B =n. □ X □□ parameter setting table

Parameter		Meaning	When enabled	Classification
Pn00B (Function selection application switch B)	n. □ 0 □□ (Default value)	Use a three-phase power supply input.	After restart	Setup
	n. □ 1 □□	Use a three-phase power supply input as a single-phase power supply input.		

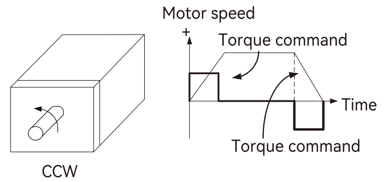
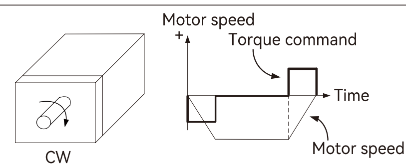
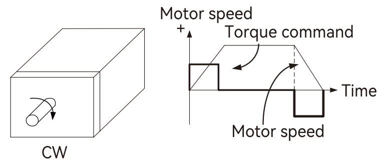
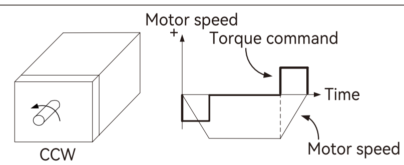
Note: 1. If you use a single-phase power supply input without specifying a single-phase AC power supply (Pn00B = n. □ 1 □□), an A.F10 alarm (Power supply line open phase) will occur.

2. When using single-phase 220V power input, do not connect the L3 terminal.

5.4.2 Setting rotation direction of servo motor

The rotation direction of the servo motor can be reversed through Pn000.0 without changing the PLC command. This causes the rotation direction of the servo motor to change, but the polarity of the signals, such as encoder output pulses, output from the servo unit do not change.

Table 5-8 Pn000 servo motor rotation direction switching table

Parameter		Forward / reverse command	Motor rotation direction	Applicable over-travel signal (OT)
Pn000	n. □□□ 0 Use CCW as the forward direction. (Default value)	Forward command		P-OT
		Reverse command		N-OT
	n. □□□ 1 Use CW as the forward direction. (Reverse rotation mode)	Forward command		P-OT
		Reverse command		N-OT

Note: The "forward rotation direction" under the default setting is "counterclockwise rotation (CCW)" viewed from the load side of the servo motor.

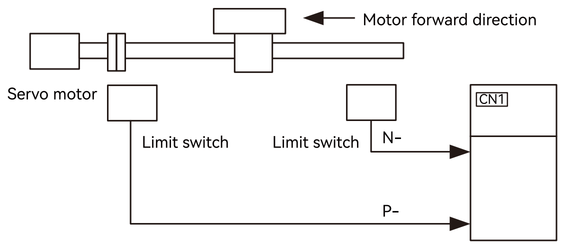
5.4.3 Overtravel setting

Overtravel is a function of the servo unit that forces the servo motor to stop in response to a signal input from a limit switch that is activated when a moving part of the machine exceeds the safe range of movement.

For rotary applications such as round tables and conveyors, the overtravel function may not be required, and in this case, the input signal wiring for overtravel is also unnecessary.

NOTE ⚠

- **Limit switch installation**



- **Precautions when external force are applied to servo motor shaft during overtravel:**

1. The /BK (Brake) signal will remain ON (the brake will be released) when overtravel occurs. This may result in the workpiece falling when overtravel occurs. To prevent the workpiece from falling, set Pn001 to n. □□ 1 □ to place the servo motor in a zero-clamped state when it stops.

2. A base block state is entered after stopping for overtravel. This may cause the servo motor to be pushed back by an external force on the load shaft. To prevent the servo motor from being pushed back, set Pn001 to n. □□ 1 □ to place the servo motor in zero-clamped state when it stops.

Note: When the servo motor stops due to overtravel during position control, the position deviation is held. You must input the CLR (Clear) signal to clear the position deviation.

I. Forward/reverse overtravel (P-OT, NOT) signal setting

Table 5-9 Forward/reverse overtravel (P-OT, N-OT) setting table

	Bit0~1 signal assignment definition		Bit2 polarity control definition		Bit3 axis selection definition	
Pn590~Pn5A4	n. □□ 00	Undefined	n. □ 0 □□	No inversion (same polarity)	n.0 □□□	Not used
	n. □□ 01	Positive overtravel switch (/POT)	n. □ 1 □□	Signal inversion (reverse polarity)	n.1 □□□	A axis
	n. □□ 02	Negative overtravel switch (/NOT)	n. □ 2 □□	Forced invalid	n.2 □□□	B axis
	—		n. □ 3 □□	Forced valid	n.3 □□□	C axis
			—		n.4 □□□	D axis
					n.5 □□□	All axes

II. Motor stopping method for overtravel

When overtravel occurs, you can choose any of the following three methods to stop the servo motor through Pn001:

① Dynamic brake (DB) stop: By short-circuiting the electrical circuit, the servo motor is stopped urgently.

② Deceleration to stop: Deceleration to stop by emergency stop torque.

③ Coasting to stop stop: stop naturally due to friction when the motor rotates.

After stopping, there are the following two states:

① Coasting to stop status: The state of natural stop due to friction when the motor rotates.

② Zero position fixed state: the state of maintaining the zero position in the position loop.

Table 5-10 Pn001=n. □□ X □ stop method setting table for overtravel

Parameter		Motor stop method	State after motor stops	When enabled	Classification
Pn001 (Function select application switch 1)	n. □□ 0 □	Dynamic brake	Lock	After restart	Setup
	n. □□ 1 □		Coasting to stop		
	n. □□ 2 □	Coasting to stop			
	n. □□ 3 □	Maximum torque stop	Lock		
	n. □□ 4 □		Coasting to stop		
	n. □□ 5 □	Decelerate to stop	Lock		
	n. □□ 6 □		Coasting to stop		

Note: Deceleration to stop is not possible in torque control. With the setting of Pn001.0, the status of servo motor is coasting to stop after the servo motor stops performing DB or coasting to stop.

When the motor stop method is selected as deceleration stop:

Set Pn406 (Emergency stop toque) to stop the servo motor by setting emergency stop torque, the default setting is 800%. And it will actually stop according to the maximum torque of the motor.

Table 5-11 Pn406 deceleration stop setting table

Pn406	Emergency stop torque	Speed Position Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0~800	1%	800%		

III. Overtravel warning function

You can set the system to detect an A.9A0 warning (Overtravel) if overtravel occurs while the servo is ON. This allows the servo unit to notify the host controller with a warning even when the overtravel signal is input only momentarily. It can be set by Pn00D = n. X □□□ . Overtravel warnings are also synchronized to error code 603Fh and servo error codes to 213Fh.

Table 5-12 Pn00D=n. X □□□ overtravel warning setting table

Parameter		Meaning	When enabled	Classification
Pn00D (Function selection application switch D)	n.0 □□□ (Default value)	Do not detect overtravel warnings	Immediately	Setup
	n.1 □□□	Detect overtravel warnings,		

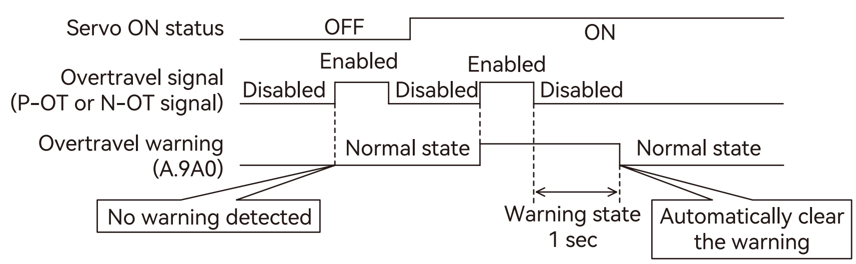


Figure 5-2 Overtravel detected timing chart

Information:

1. Warnings are detected for overtravel in the same direction as the reference.

2. Warnings are not detected for overtravel in the opposite direction from the reference.

3. A warning can be detected in either the forward or reverse direction if there is no command.

4. A warning will not be detected when the servo is OFF even if overtravel status exists.

5.A warning will not be detected when the servo is turned ON even if overtravel status exists.

6. The warning status will be held for one second after the overtravel status no longer exists and it will then be cleared automatically.

Note: The overtravel warning function is only the action of detecting the warning. It will not affect the stop processing of the overtravel and the motion control of the PLC device. But the motor has not reached the PLC command position, so please check the PLC command.

5.4.4 Holding brake

Since the gravity in the Z-axis direction will cause the mechanism to slide down, the holding brake is more often used in the Z-axis direction. Using the brake can prevent the moving part from falling down, and also prevent the servo motor from continuously exerting a large resistance (if the servo continues to exert force, a large amount of heat will be generated, which will reduce the service life of the motor). The electromagnetic brake will cause unnecessary malfunction, and the brake must be applied after the servo is turned off. The brake is controlled by DO (/BK signal), and the user can use Pn506, Pn507 and Pn508 to set the relevant delay time.

The holding brake is used in the following cases:

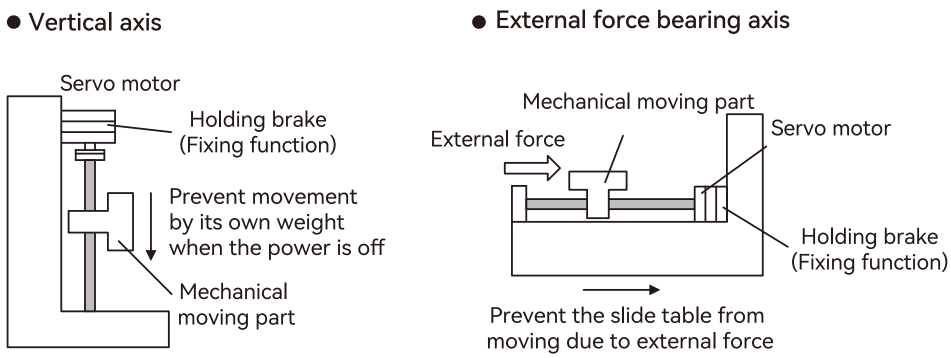


Figure 5-3 Cases for holding brake

Electromagnetic brake control timing chart:

Please consider the brake release delay and set the parameters in the timing sequence as shown in the figure below.

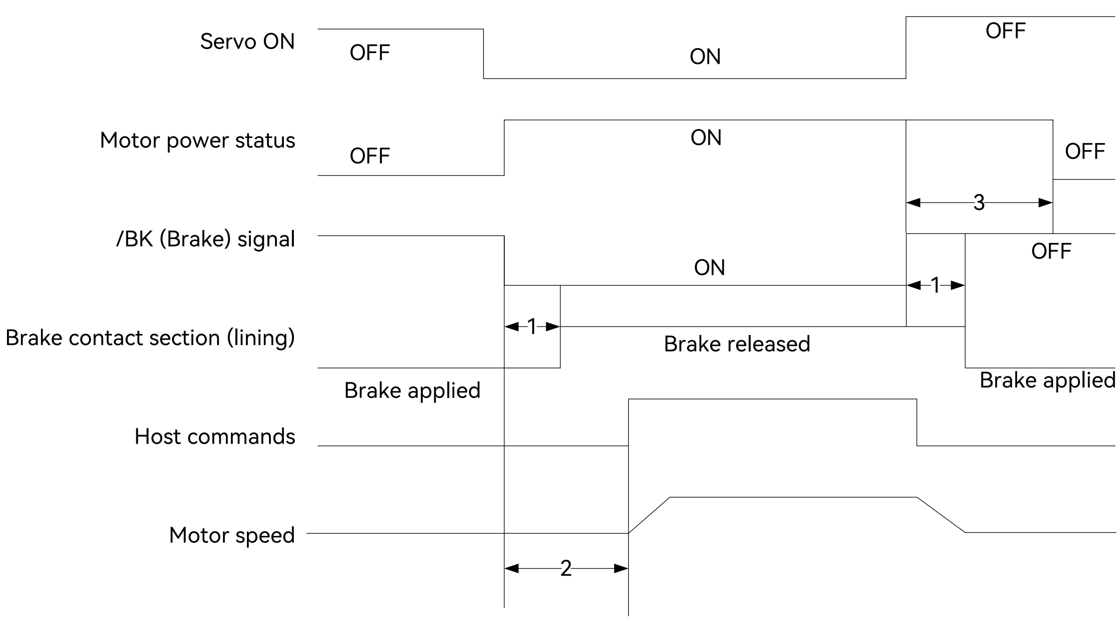


Figure 5-4 Electromagnetic brake timing chart

Note: 1. Before you output a reference from the host controller to the servo unit, wait for at least 50 ms plus the brake release delay time after you turn ON the /S-ON signal.

2. Please set the brake operate and servo OFF time through Pn506, Pn507 and Pn508.

3. It can only be used for holding and not for braking. Please use it with the servo OFF.

I. Brake signal

Output signal that controls the brake. The brake signal is not assigned at the factory. Assign it via "(3) Brake signal (/BK) assignment".

When servo is OFF or an alarm is detected, /BK turns OFF (brake operates). Adjust the OFF time via Pn506.

When servo is ON, /BK turns ON (brake not operated).

Note: In overtravel state, the /BK signal remains ON and the brake remains released.

The brake signal (/BK) is not assigned at the factory. Assign it using Pn676=n. □□□□ .

Table 5-13 Pn676=n. □□□□ internal brake configuration setting table

Parameter		Meaning	When enabled	Classification
Pn676 (Internal brake configuration)	n. □□□ 0 (Default value)	BK signal not used	After restart	Setup
	n. □□□ A	Brake A used		
	n. □□□ B	Brake B used		
	n.0 □□□ (Default value)	BK signal not used		
	n.1 □□□	BK signal output in forward direction		
	n.2 □□□	BK signal output in reverse direction		

Note: If you allocate more than one signal to the same output connector pin, a logical OR of the signals is output. Allocate the /BK signal to its own output connector pin, i.e., do not use the same output terminal for another signal.

II. Output timing of brake signal (/BK) (when the motor stops)

When the servo motor stops, the brake (/BK) signal and the servo ON (/S-ON) signal are OFF at the same time . By setting Pn506, the time from the servo ON (/S-ON) signal OFF to the motor entering the non-energized state can be changed.

Table 5-14 Pn506 brake signal (/BK) setting table

Pn506	Brake command - Servo OFF delay time		Speed / Position / Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0~100	10ms	20		

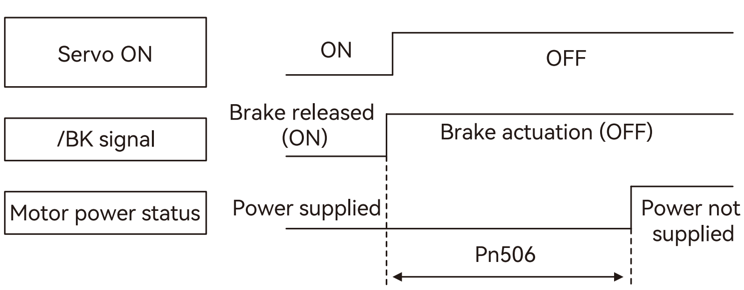


Figure 5-5 Brake signal (/BK) output timing chart (Servo motor stops)

Note: 1. When the servo motor is used to control a vertical axis, the machine moving part may move slightly due to gravity or an external force. You can eliminate this slight motion by setting the servo OFF delay time so that power supply to the motor is stopped after the brake is applied.

2. When an alarm occurs, the servo motor immediately enters a unpowered state regardless of the setting. Therefore, due to the self-weight or external force of the mechanical moving part, the machine sometimes will move before the brake operates.

III. Output timing of brake signal (/BK) (when the motor is operating

If an alarm occurs while the servo motor is operating, the servo motor will start stopping and the /BK signal will be turned OFF. You can adjust the timing of /BK signal output by setting the brake command output speed level Pn507 and the servo OFF-Brake Command Waiting Time (Pn508).

Note: The stop method when the alarm occurs is the setting of the electronic gear. After the motor is stopped by the zero-speed command, follow the output sequence of " 5.3.6 (2) Brake signal (/BK) (when motor is stopped)".

The brake operates when either of the following conditions is satisfied:

1. When the motor speed goes below the level set in Pn507 for a servo motor after the power supply to the motor is stopped.

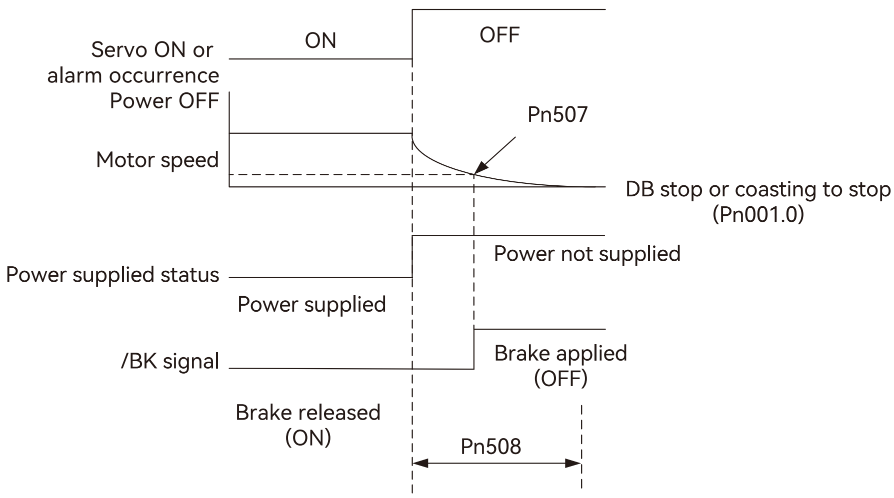


Figure 5-6 Signal brake (/BK) output timing chart 1 (When motor is operating)

2. When the time set in Pn508 elapses after the power supply to the motor is stopped.

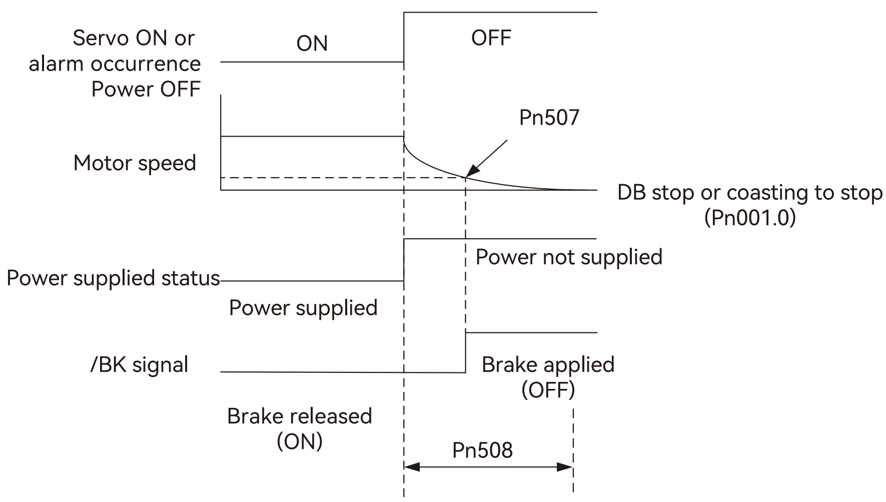


Figure 5-7 Signal brake (/BK) output timing chart 2 (When motor is operating)

E

• Basic Function of Servo

Table 5-15 Pn507/ Pn508 brake operating table

Pn507	Brake command output speed level	Speed Position Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	—	—	—		
Pn508	Servo OFF-brake command waiting time	Speed Position Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	10-100	10ms	50		

5.4.5 Motor stopping methods for servo OFF and alarms

CAUTION

・The dynamic brake is used for emergency stops. The dynamic brake circuit will operate frequently if the power supply is turned ON and OFF or the servo is turned ON and OFF while a reference input is applied to start and stop the servo motor. This may result in deterioration of the internal elements in the servo unit. Use speed input references or position references to start and stop the servo motor.

・If you turn OFF the main circuit power supply or control power supply during operation before you turn OFF the servo, the servo motor stopping method depends on the servo unit model as shown in the following table.

・If the servo motor must be stopped by coasting rather than with the dynamic brake when the main circuit power supply or the control power supply is turned OFF before the servo is turned OFF, combine the sequence signals externally to disconnect the wiring (U, V, W) of the servo motor.

・To minimize the coasting distance of the servo motor to come to a stop when an alarm occurs, zero-speed stopping is the default method for alarms to which it is applicable. However, depending on the application, stopping with the dynamic brake may be more suitable than zero-speed stopping.

I. Stopping method for servo OFF

Table 5-16 Pn001 stopping setting table (When servo is OFF)

Parameter		Motor stop method	State after motor stops	When enabled	Classification
Pn001 (Function select application switch 1)	n. □□□ 0	DB	DB	After restart	Setup
	n. □□□ 1		Coasting to stop		
	n. □□□ 2	Coasting to stop	Coasting to stop		
	n. □□□ 3	Maximum torque stop	DB		
	n. □□□ 4		Coasting to stop		
	n. □□□ 5	Decelerate to stop	DB		
	n. □□□ 6 (Default value)		Coasting to stop		

II. Stopping method for Alarms

According to the stop method when the alarm occurs, there are two types of alarms BM. 1 and BM. 2 which are selected by Pn001.0 and Pn00B.1.

When BM.1 alarm occurs, the servo motor will stop according to the setting of Pn001.0.

When BM.2 alarm occurs, the servo motor will stop according to the setting of Pn00B.1.

Please refer to the following tables to check BM.1 alarm or BM.2 alarm.

Table 5-17 Parameter setting table when BM.1 alarm occurs (Same as servo OFF)

Parameter		Motor stop method	State after motor stops	When enabled	Classification
Pn00A (Function select application switch A)	n. □□□ 0 (Default value)	DB	DB	After restart	Setup
	n. □□□ 1		Coasting to stop		
	n. □□□ 2	Coasting to stop	Coasting to stop		

Table 5-18 Parameter setting table when BM.2 alarm occurs

Parameter		Motor stop method	State after motor stops	When enabled	Classification
Pn00B (Function select application switch B)	n. □□□ 0	DB	DB	After restart	Setup
	n. □□□ 1		Coasting to stop		
	n. □□□ 2	Coasting to stop	Coasting to stop		
	n. □□□ 3 (Default value)	Maximum torque stop	DB		
	n. □□□ 4		Coasting to stop		
	n. □□□ 5	Decelerate to stop	DB		
	n. □□□ 6		Coasting to stop		

III. Stop method during forced stop

Table 5-19 Stop method during forced stop

Parameter		Motor stop method	State after motor stops	When enabled	Classification
Pn00A (Function select application switch A)	n. □□ 0 □ (Default value	DB	DB	After restart	Setup
	n. □□ 1 □		Coasting to stop		
	n. □□ 2 □	Coasting to stop	Coasting to stop		

IV. Deceleration time for decelerating to stop

Set the time required for the motor to decelerate from its maximum speed to 0 rpm during the stopping process.

Table 5-20 Setting table for Pn31A (Set deceleration time)

Pn30A	Deceleration time for decelerating to stop			When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0~10000	1ms	100		

Deceleration time for decelerating to stop =Target speed/Rated speed x Soft start (Deceleration time Pn31A)

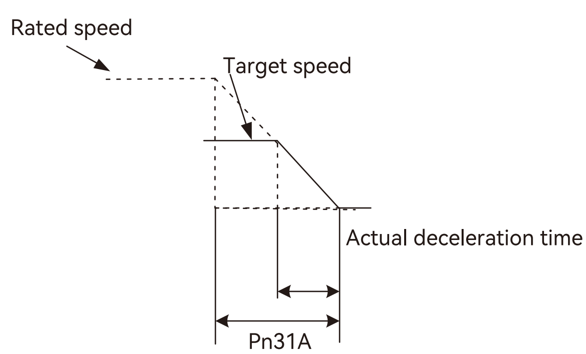


Figure 5-8 Deceleration time diagram for decelerating to stop

5.4.6 Operation for momentary power interruptions

Even if the main power supply to the servo unit is interrupted momentarily, power supply to the motor (servo ON status) will be maintained for the time set in Pn509 (Momentary power interruption hold time).

Table 5-21 Pn509 (Momentary power interruption hold time) setting table

Pn509	Momentary power failure holding time	Speed Position Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	20-50000	1ms	20		

If the momentary power interruption time is equal to or less than the setting of Pn509, power supply to the motor will be continued. If it is longer than the setting, power supply to the motor will be stopped Power will be supplied to the motor again when the main circuit power supply recovers.

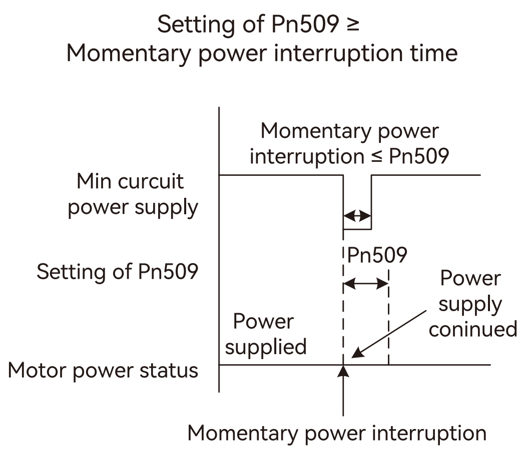


Figure 5-9 Main circuit power supply and servo motor power status (Pn509 value ≥ momentary power interruption time)

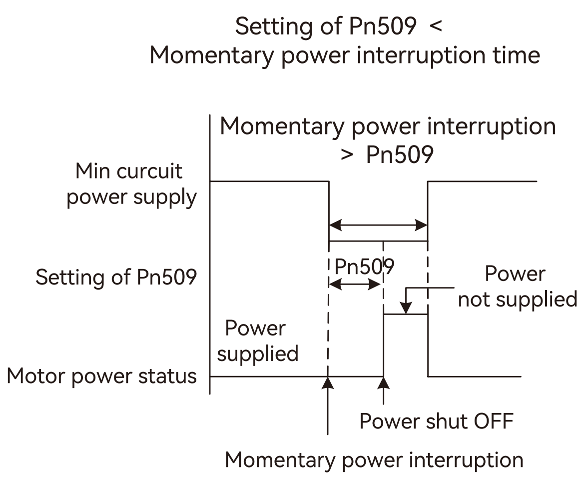


Figure 5-10 Main circuit power supply and servo motor power status (Pn509 value ≤ momentary power interruption time)

Information:

1. If the momentary power interruption time exceeds the setting of Pn509, the /S-RDY (Servo Ready) signal will turn OFF and servo is OFF.

2. If uninterruptible power supplies are used for the control power supply and main circuit power supply, the servo unit can withstand a power interruption that lasts longer than 1,000 ms.

3. The holding time of the servo unit control power supply is approximately 100 ms. If control operations become impossible during a momentary power interruption of the control power supply, the setting of Pn509 will be ignored and the same

operation will be performed as for when the power supply is turned OFF normally.

When performing the same operation, the setting of Pn509 will be ignored.

5.4.7 Setting of motor overload detection value

The motor overload detection value is the value (threshold value) at which an overload warning and an overload alarm are detected when a continuous load exceeding the rated value of the servo motor is applied.

It prevents the servo motor from overheating.

The servo unit is able to change the detection time of A.910 (overload warning) and A.720 (overload (continuous maximum) alarm). However, the detection value of A.710 (overload characteristics and overload (instantaneous maximum) alarm) cannot be changed.

Detection time of overload warning (A.910)

With the default setting for overload warnings, an overload warning is detected in 20% of the time required to detect an overload alarm. You can change the time required to detect an overload warning by changing the setting of the overload warning level (Pn52B). You can increase safety by using overload warning detection as an overload protection function matched to the system

For example, if the overload warning value (Pn52B) is changed from 20% to 50%, an overload warning is detected in half of the time required to detect an overload alarm.

Table 5-22 Pn52B (Overload warning level) setting table

Pn52B	Overload warning level		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	1 ~ 100	1%	20		

Detection Timing for Overload Alarms (A.720)

If servo motor heat dissipation is insufficient (e.g., if the heat sink is too small), you can lower the overload alarm detection level to help prevent overheating.

To reduce the overload alarm detection level, change the setting of Pn52C (Base Current Derating at Motor Overload Detection)

Table 5-23 Pn52C (Base current derating at motor overload detection) setting table

Pn52C	Base current derating at motor overload		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	After restart	Setup
	10 ~ 100	1%	100		

An A.720 alarm (Continuous overload) can be detected earlier to protect the servo motor from overloading.

5.4.8 Regenerative resistor capacity setting

If an external regenerative resistor is connected, you must set Pn600.

If you set Pn600=0 with external regenerative resistor connected, A.320 alarms (Regenerative overload) will not be detected correctly, and the external regenerative resistor may be damaged or personal injury or fire may result.

Table 5-24 Pn600 (Regenerative resistor capacity) setting table

Pn600	Regenerative resistor capacity		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0 - Servo unit's maximum applicable motor capacity	10W	0		

The setting of regenerative resistance capacity depends on the way of external cooling.

1. For self-cooling (natural convection cooling): Set the parameter to a maximum 20% of the capacity (W) of the actually installed regenerative resistor.

2. For forced air cooling: Set the parameter to a maximum 50% of the capacity (W) of the actually installed regenerative resistor.

(Example)For a self-cooling 50W external regenerative resistor, set Pn600 to 1 (×10 W) (50 W ×20% = 10 W).

Note: 1. When an external regenerative resistor is used at the normal rated load ratio, the resistor temperature increases to between 200° C and 300° C. Always apply derating. Consult the manufacturer for the resistor's load characteristics.

2. For safety, use an External Regenerative Resistor with a thermoswitch.

Table 5-25 Setting table for Pn630 (Resistance value of external regenerative resistance)

Pn630	Resistance value of external regenerative		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	After restart	Setup
	0~65535	220V: 10mΩ 380V: 10mΩ	0		

5.5 Other input and output signals

5.5.1 Alarm output (ALM) signal

This signal is output when the servo unit detects an error. The connection terminal can be self-allocated.

Table 5-26 Alarm signal output

Type	Signal	A axis connector pin No.	B axis connector pin No.	B axis connector pin No.	B axis connector pin No.	Status	Meaning
Output	Alarm output (ALM)	CN1-9	CN1-7	CN1-5	CN1-3	ON (closed)	Normal status
						OFF (open)	Servo drive alarm

5.5.2 Warning output (/WARN) signal

Both alarms and warnings are generated by the servo unit. Alarms indicate errors in the servo unit for which operation must be stopped immediately. Warnings indicate situations that may results in alarms but for which stopping operation is not yet necessary.

Table 5-27 Warning signal output

Type	Signal	Connector pin No.	Status	Meaning
Output	Warning output (/WARN)	Must be allocated	ON (closed)	Normal status
			OFF (open)	Servo drive alarm

5.5.3 Rotation detection output signal (/TGON)

This signal is output when the shaft of the servo motor rotates faster than the setting of Pn502.

Table 5-28 Rotation detection output

Type	Signal	Connector pin No.	Status	Meaning
Output	Rotation detection output signal (/TGON)	Self-allocated	ON (closed)	The Servo motor is operating faster than the setting of Pn502
			OFF (open)	The Servo motor is operating slower than the setting of Pn502

Rotation detection output (/TGON) parameters:

Use the following parameter to set the speed detection level at which to output the /TGON signal.

Table 5-29 Pn502 (Rotation detection level) parameter setting

Pn502	Rotation detection level		Speed Position Torque	When enabled	Classification
	Setting range	Immediately	Default value	Immediately	Setup
	0-10000	rpm	20		

5.5.4 Servo ready output (/S-RDY) signal

The /S-RDY (Servo ready) signal turns ON when the servo unit is ready to accept the /S-ON (Servo ON) input signal.

Table 5-30 Servo ready signal output

Type	Signal	A axis connector pin No.	B axis connector pin No.	B axis connector pin No.	B axis connector pin No.	Status	Meaning
Output	Servo ready output (/S-RDY)	CN1-10	CN1-8	CN1-6	CN1-4	ON (closed)	Ready to receive the /S-ON (Servo ON) signal
						OFF (open)	Not ready to receive the / S-ON (Servo ON) signal

Note: The /S-RDY signal is turned ON when the main circuit power is ON, there is no hard wire base block state, and there are no alarms.

5.6 Electronic gear ratio

The essential of electronic gear ratio is the corresponding travel distance of motor for a load shaft travel distance of 1 reference unit (Unit: encoder unit)

The gear ratio consists of the numerator 6091-01h and the denominator 6091-02h. The gear ratio establishes a proportional relationship between the load shaft travel distance (reference unit) and the travel distance (encoder unit): Motor travel distance = Load shaft travel distance × Gear ratio

The motor is connected to the load parts by means of gearbox and other mechanical transmissions. Therefore, the gear ratio is related to the mechanical reduction ratio, mechanical dimensions, and the resolution of the motor. The calculation method is as follows

Gear ratio= Motor resolution / Load shaft resolution;

Gear ratios are used to establish a specified ratio of load shaft travel distance to motor shaft travel distance.

Table 5-31 Electronic gear ratio settings

Pn78C	Electronic gear ratio numerator		Position	When enabled	Classification
	Setting range	Unit	Default value	After start	Setup
	1-4294967295	—	1		

<table>
<tr><td rowspan="3">Pn78E</td><td colspan="3">Electronic gear ratio denominator   Position</td><td>When enabled</td><td>Classification</td></tr>
<tr><td>Setting range</td><td>Unit</td><td>Default value</td><td rowspan="2">After start</td><td rowspan="2">Setup</td></tr>
<tr><td>1-4294967295</td><td>—</td><td>1</td></tr>
</table>

If the gear ratio between servo motor shaft and the load is given as n/m:

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{\text{Pn78C}}{\text{Pn78E}} = \frac{\text{Encoder resolution}}{\text{Pluses per load shaft revolution}} \times \frac{m}{n}$$

The encoder resolution can be checked by the motor model as follows:

X6 series- □□□□□□□□□

Table 5-32 Encoder resolution selection table

Code	Specification	Encoder resolution
A	17-bit absolute type (multi-turn)	131072 (2^{17})
D	23-bit absolute type (multi-turn)	8388608 (2^{23})

Note: Electronic gear ratio setting range: 0.001 ≤ electronic gear ratio (B/A) ≤ Encoder resolution * 0.4, if it is not within the range, "parameter setting abnormality (A.040) alarm" will occur.

5.7 Profile position mode, PP

In the Profile Position Mode, there are absolute positioning and relative positioning for drive controlling the motor. The host controller is able to set target position, start velocity, stop velocity and aceeleration(deceleration). Set object 6060H to 1 to enable Profile Position Mode. The control block diagram and input/output are shown in the following two figures.

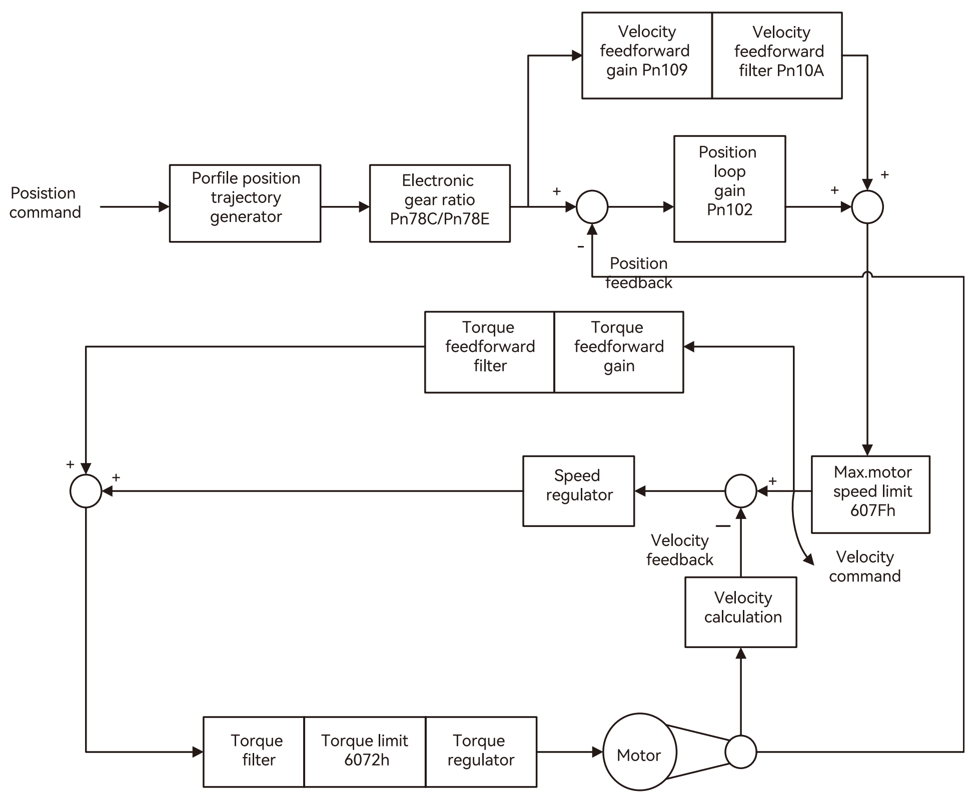


Figure 5-11 Blocking diagram for profile position mode

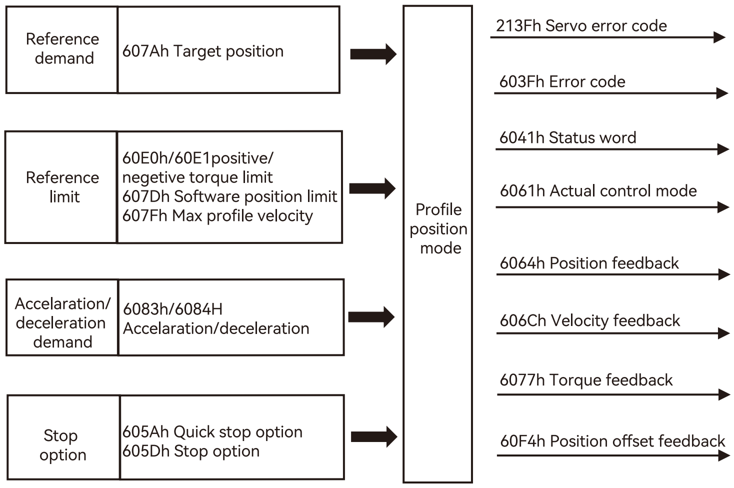


Figure 5-12 Profile position mode input/output

5.7.1 Control word in profile position mode (60400010h)

In profile position mode, the meaning of control word(6040h) is as the table below. The item in dark background indicates the dedicated control reference in profile position mode.

Table 5-33 Description of control word in profile position mode

Bit	Name	Description
0	Switch on	Must be set to 1 when enable the servo
1	Enable voltage	Must be set to 1 when enable the servo
2	Quick stop	Must be set to 1 when enable the servo, if set to 0 then quick stop
3	Operation enable	Must be set to 1 when enable the servo
4	Update position reference	When 0 → 1, load the next positioning operation(including target position or position increment, start velocity, operation velocity and acceleration(deceleration)
5	Update immediately	0: Starts the next positioning operation after the current positioning operation is completed 1: Stop the current operation and starts the next positioning operation immediately
6	Position reference type	0: absolute position reference, 1: relative position reference
7	Fault reset	When 0 → 1 executes alarm reset for once. If multiple resets are required, multiple changes from 0 → 1 are required. When it is set to 1, other control reference is disabled.
8	Halt	0: disabled, 1: enabled. When enabled the operation is halted.
9	PP mode reserved	-
10	Reserved	-
11~15	Customized	-

5.7.2 Status word in profile position mode (60410010h)

The meaning of status word(6041h) is as the table below in profile position mode. The item in dark background indicates the dedicated control reference in profile position mode.

Table 5-34 Status word description in profile position mode

Bit	Name	Description
0	Ready to switch on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.

1	Switched on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
2	Operation enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled.
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disbaled, 1: Enabled. When enabled it indicates Servo can be enabled.
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
7	Warning	0: No warning, 1: Warning
8	Customized	-
9	Remote	0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled.
10	Target reached	60400010h bit 8 (halt)=0, 0: Target position is not reached 1: Target position is reached; 60400010h bit 8 (halt)=1, 0: Decelerating, 1: Velocity is 0
11	Internal software limit active	0: Software limit position is not reached. 1: Sotware limit position is reached
12	Received status of new position reference	0: Position reference can be updated. 1: Position reference cannot be updated.
13	Position offset error	0: Position offset value 在规 Setting range 之内 (6065h) 1: Position offset value 超过 Setting range (6065h)
14	Customized	-
15	Homing completed	0: Position offset value is in the set range(6065h) 1: Position offset value is out of the set range(6065h)

5.7.3 Related parameter of profile position mode

Table below shows related objects dictionary in profile position mode.

Table 5-35 Object Dictionary List of Profile Torque Mode

Index	Subindex	Name	Access	Data type	Default value
6040h	—	Control word	rw	unsigned16	0
6041h	—	Status word	ro	unsigned16	0
6060h	—	Control mode	rw	integer8	0
6061h	—	Control mode display	ro	integer8	0
6062h	—	User position reference	ro	integer32	0
6063h	—	Motor position feedback	ro	integer32	0
6064h	—	User position feedback	ro	integer32	0
6065h	—	User position offset threshold	rw	unsigned32	0
6067h	—	Position threshold	rw	unsigned32	50
6068h	—	Position reaching time	rw	unsigned16	0
606Bh	—	Velocity demand value	ro	integer32	0
606Ch	—	Velocity actual value	ro	integer32	0
607Ah	—	Target position	rw	integer32	0
607Ch	—	Home offset	rw	integer32	0
607Dh	01h	Software position limit: min position limit	rw	integer32	-2147483648
	02h	Software position limit: max position limit	rw	integer32	2147483647
607Eh	—	Reference polarity	rw	unsigned8	0

607Fh	—	Max profile velocity	rw	unsigned32	2147483647
6080h	—	Max profile velocity	rw	unsigned32	10000
6081h	—	Profile velocity	rw	unsigned32	0
6083h	—	Profile acceleration	rw	unsigned32	10485760
6084h	—	Profile deceleration	rw	unsigned32	10485760
60F4h	—	User Position offset	ro	integer32	0
60FCh	—	Motor position reference feedback	ro	integer32	0

5.7.4 Simple tutorial for profile position mode

I. Parameter setting in servo drive

Table 5-36 Parameter of servo drive for operating profile position mode

Parameter	Set value	Description
Pn002.2	1	Take absolute encoder as incremental. No need to change the parameter in absolute system.
Pn00B.2	1	Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter.

II. The host controller connects to servo drive and set configuration PDO

III. Run the host controller.

Table 5-37 Profile position mode startup and operation

Address	Name	Value setting (decimal value)
60600008h	Control mode	1
607A0020h	Demand position	Set by user
60810020h	Demand velocity in profile position loop	-2147483648~2147483647
60400010h Control word	Enable	Any number → 6 → 7 → 15/47/79/111
	Alarm clear	Any number → 128 (Enabled on rising edge)
	Demand absolute position(Not update immediately)	6 → 7 → 15 → 31
	Demand absolute position(Update immediately)	6 → 7 → 47 → 63
	Demand relative position(Not update immediately)	6 → 7 → 79 → 95
	Demand relative position(Update immediately)	6 → 7 → 111 → 127
60830020h	Profile acceleration	-2147483648~2147483647
60840020h	Profile deceleration	-2147483648~2147483647
607F0020h	Max. profile velocity	-2147483648~2147483647

5.8 Profile velocity mode, PV

In the Profile Velocity Mode, target acceleration and declaration can be set by host controller. When profile velocity mode is enabled, 6060H is set to 3. It is available for EtherCAT. The control block diagram and input/output are shown in the following two figures.

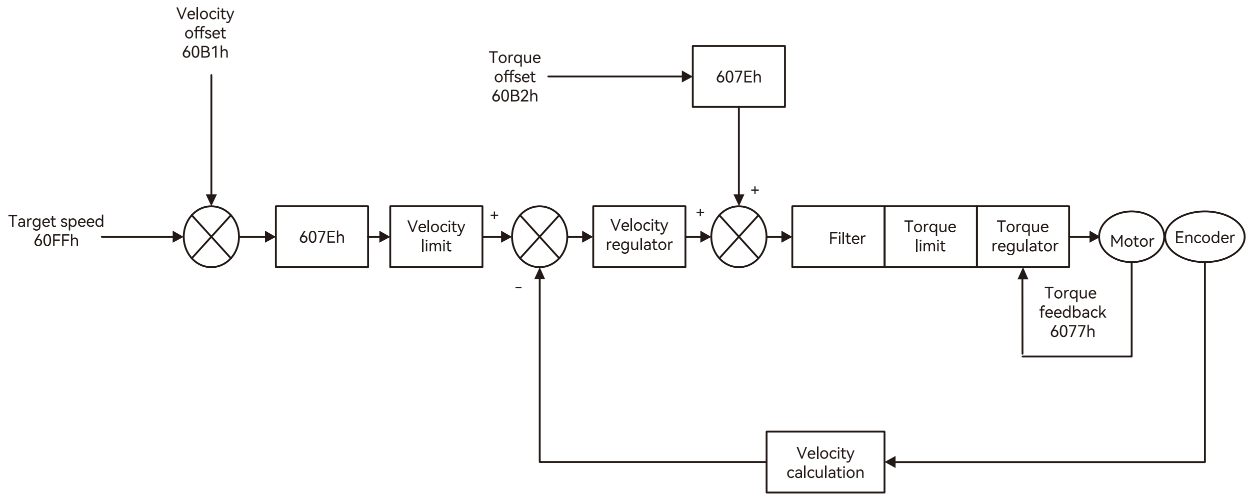


Figure 5-13 Block diagram for profile velocity mode

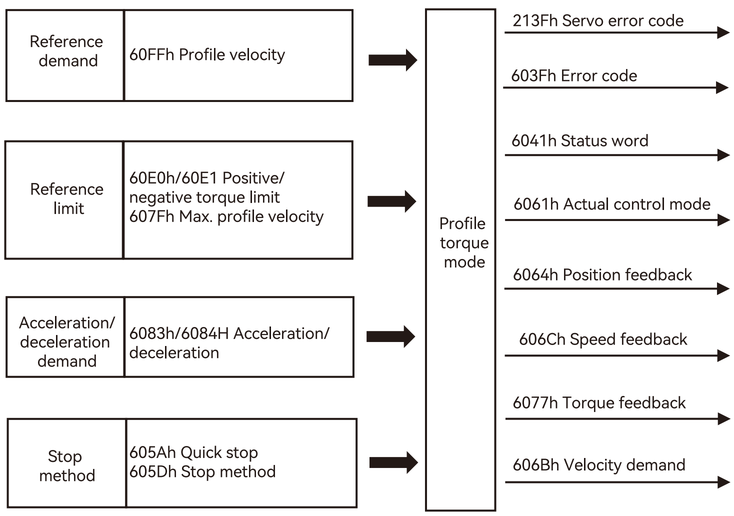


Figure 5-14 Profile velocity mode input/output

5.8.1 Profile velocity mode control word setting (60400010h)

In profile velocity mode, the meaning of control word is shown as the table below. The item in dark background indicates the dedicated control reference in profile velocity mode.

Table 5-38 Description of control word in profile velocity mode

Bit	Name	Description
0	Switch on	Must be set to 1 when enable the servo
1	Enable voltage	Must be set to 1 when enable the servo
2	Quick stop	Must be set to 1 when enable the servo. When set to 0 then quick stop
3	Operation enable	Must be set to 1 when enable the servo
4 ~ 6	Reserved for PV Mode	-

7	Fault reset	When 0 → 1 exucutes alarm reset for once. If multiple resets are required, multiple changes from 0 → 1 are required. When it is set to 1, other control reference is disabled.
8	Halt	0: Disbaled, 1: Enabled. When disabled reference is executed, When enabled then halt.
9	Reserved for PV Mode	-
10	Reserved	-
11~15	Customized	-

5.8.2 Status word in profile position mode (60410010h)

In profile velocity mode, the meaning of bit of status word is shown as table below. The item in dark background indicates the dedicated control reference in profile velocity mode.

Table 5-39 Description of status word in profile velocity mode

Bit	Name	Description
0	Ready to switch on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
1	Switched on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
2	Operation enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled.
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
7	Warning	0: No warning, 1: Warning
8	Customized	-
9	Remote	0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled.
10	Target reached	60400010h bit 8 (halt)=0, 0: Target velocity is not reached, 1: Target velocity is reached 60400010h bit 8 (halt)=1, 0: Decelerating, 1: Velocity is 0
11	Internal software limit active	0: Software limit position is not reached. 1: Sotware limit position is reached
12	Zero velocity status	0: Velocity is not 0, 1: Velocity is 0
13	Reserved for PV mode	-
14 ~ 15	Customized	-

5.8.3 Related parameter of profile velocity mode

As shown in the table below, the object dictionaries involved in profile position mode are listed.

Table 5-40 Object dictionary list of profile torque mode

Index	Subindex	Name	Access	Data type	Default value
6040h	—	Control word	rw	unsigned16	0
6041h	—	Status word	ro	unsigned16	0
6060h	—	Control mode	rw	integer8	0
6061h	—	Control mode display	ro	integer8	0
6063h	—	Motor position feedback	ro	integer32	0
6064h	—	User position feedback	ro	integer32	0
606Bh	—	User velocity reference value	ro	integer32	0

606Ch	—	User actual velocity feedback	ro	integer32	0
606Dh	—	Velocity threshold	rw	unsigned16	10
606Eh	—	Velocity reaching time	rw	unsigned16	0
607Ch	—	Home offset	rw	integer32	0
607Dh	01h	Software position limit: min position limit	rw	integer32	-2147483648
	02h	Software position limit: max position limit	rw	integer32	2147483647
607Eh	—	Reference polarity	rw	unsigned8	0
607Fh	—	Max profile velocity	rw	unsigned32	2147483647
6080h	—	Max motor velocity	rw	integer32	10000
6083h	—	Profile acceleration	rw	unsigned32	10485760
6084h	—	Profile deceleration	rw	unsigned32	10485760
60FFh	—	Target velocity	rw	integer32	0

5.8.4 Simple tutorial for profile velocity mode

I. Parameter setting in servo drive

Table 5-41 Parameter of servo drive for operating profile velocity mode

Parameter	Set value	Description
Pn002.2	1	Take absolute encoder as incremental. No need to change the parameter in absolute system.
Pn00B.2	1	Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter.

II. The host controller connects to servo drive and set configuration PDO

III. Run the host controller

Table 5-42 Profile velocity mode startup and operation

Address	Name	Value setting (decimal value)
60600008h	Control mode	3
60FF0020h	Demand profile velocity	-2147483648~2147483647
60400010h Control word	Enable	Any number → 6 → 7 → 15
	Alarm clear	Any number → 128(Enabled on rising edge)
	Motor rotation	Demand velocity reference after enabled
60830020h	Profile acceleration	-2147483648~2147483647
60840020h	Profile deceleration	-2147483648~2147483647
607F0020h	Max. profile acceleration	-2147483648~2147483647

5.9 Profile torque mode, PT

In profile torque mode, the host controller is able to set the target torque and torque reference change rate(torque ramp). To enable the profile torque mode, set 6060H to 4. It is available for EtherCAT. The control block diagram and input/output are shown in the following two figures.

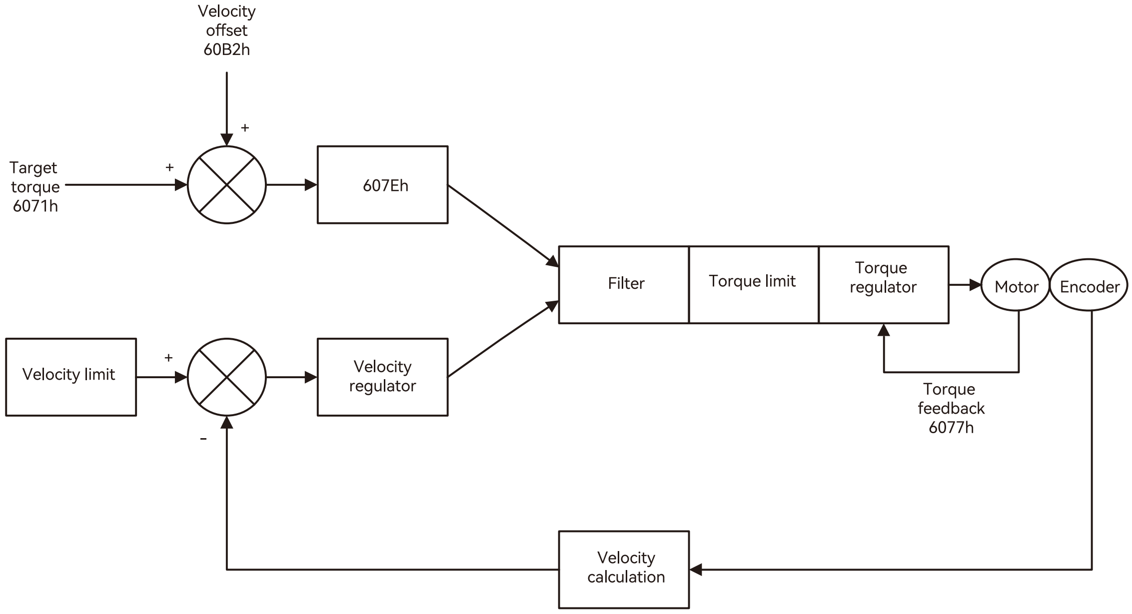


Figure 5-15 Block diagram for profile torque mode

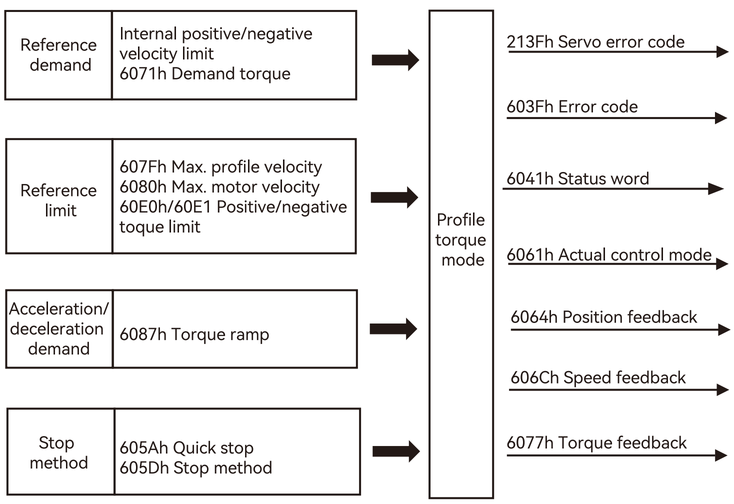


Figure 5-16 Profile torque mode input and output

5.9.1 Setting of control word in profile torque mode (60400010h)

In profile position mode, the meaning of control word(6040h) is as the table below. The item in dark background indicates the dedicated control reference in profile torque mode.

Table 5-43 Description of control word in profile torque mode

Bit	Name	Description
0	Switch on	Must be set to 1 when enable the servo
1	Enable voltage	Must be set to 1 when enable the servo
2	Quick stop	Must be set to 1 when enable the servo, if set to 0 then quick stop

3	Operation enable	Must be set to 1 when enable the servo
4 ~ 6	Reserved for PT mode	-
7	Fault reset	When 0 → 1 exucutes alarm reset for once. If multiple resets are required, multiple changes from 0 → 1 are required. When it is set to 1, other control reference is disabled.
8	Halt	0: disabled, 1: enabled. When enabled the operation is halted.
9	Reserved for PT mode	-
10	Reserved	-
11~15	Customized	-

5.9.2 Status word in profile torque mode (60410010h)

In profile torque mode, the meaning of control word(6040h) is as the table below. The item in dark background indicates the dedicated control reference in profile torque mode.

Table 5-44 Description of control word in profile torque model

Bit	Name	Description
0	Ready to switch on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
1	Switched on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
2	Operation enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled.
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
7	Warning	0: No warning, 1: Warning
8	Customized	-
9	Remote	0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled.
10	Target Torque reached	0: Target torque is not reached, 1: Target torque is reached.
11	Internal software limit activ	0: Software limit position is not reached. 1: Sotware limit position is reached
12, 13	Reserved for PT mode	-
14, 15	Customized	-
14 ~ 15	Customized	-

5.9.3 Related parameter of profile torque mode

As shown in the table below, the object dictionaries involved in profile torque mode are listed.

Table 5-45 Object dictionaries related to profile torque mode

Index	Subindex	Signal	Access	Data type	Default value
603Fh	—	Error code	ro	unsigned16	0
6040h	—	Control word	rw	unsigned16	0
6041h	—	Status word	ro	unsigned16	0
6060h	—	Control mode	rw	integer8	0
6061h	—	Control mode display	ro	integer8	0
606Ch	—	User actual velocity feedback	ro	integer32	0
6071h	—	Target torque	rw	integer16	0
6074h	—	Demand torque	ro	integer16	0

6077h	—	Actual torque feedback	ro	integer16	0
607Dh	01h	Software position limit: min position limit	rw	integer32	-2147483648
	02h	Software position limit: max position limit	rw	integer32	2147483647
607Fh	—	Max. profile velocity	rw	unsigned32	2147483647
6080h	—	Max. motor velocity	rw	unsigned32	10000
6087h	—	Torque ramp	rw	unsigned32	0

5.9.4 Related parameter of profile torque mode

I. Parameter setting in servo drive

Table 5-46 Parameter of servo drive for operating profile velocity mode

Parameter	Set value	Description
Pn002.2	1	Take absolute encoder as incremental. No need to change the parameter in absolute system.
Pn00B.2	1	Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter.

II. The host controller connects to servo drive and set configuration PDO parameters.

III. Run the host controller.

Table 5-47 Profile torque mode startup and operation

Address	Name	Value setting (decimal value)
60600008h	Control mode	4
60800020h	Max. speed limit in profile torque mode	Set by user
60710010h	Demand profile torque	Set by user
60400010h Control word	Enable	Any number → 6 → 7 → 15
	Alarm clear	Any number → 128 (Enabled on rising edge)
	Motor operates	Demand reference after enabled
60870020h	Torque ramp	Set by user(Torque reference acceleration in profile torque mode)
607F0020h	Max profile velocity	-2147483648~2147483647

5.10 Home mode, HM

According to home switch signal, limit switch signal and encoder Z signal, CiA402 protocol defines 31 methods of homing. To enabled home mode, set object 6060H to 6. It is available in EtherCAT.

Table 5-48 Table 84. Input signal corresponding servo functions and terminal configuration table

Input signal description	Function	Connector
Homing signal	Home switch	SI0(PIN40)
Positive position limit input	P-OT	SI2(PIN42)
Negative position limit input	N-OT	SI3(PIN43)

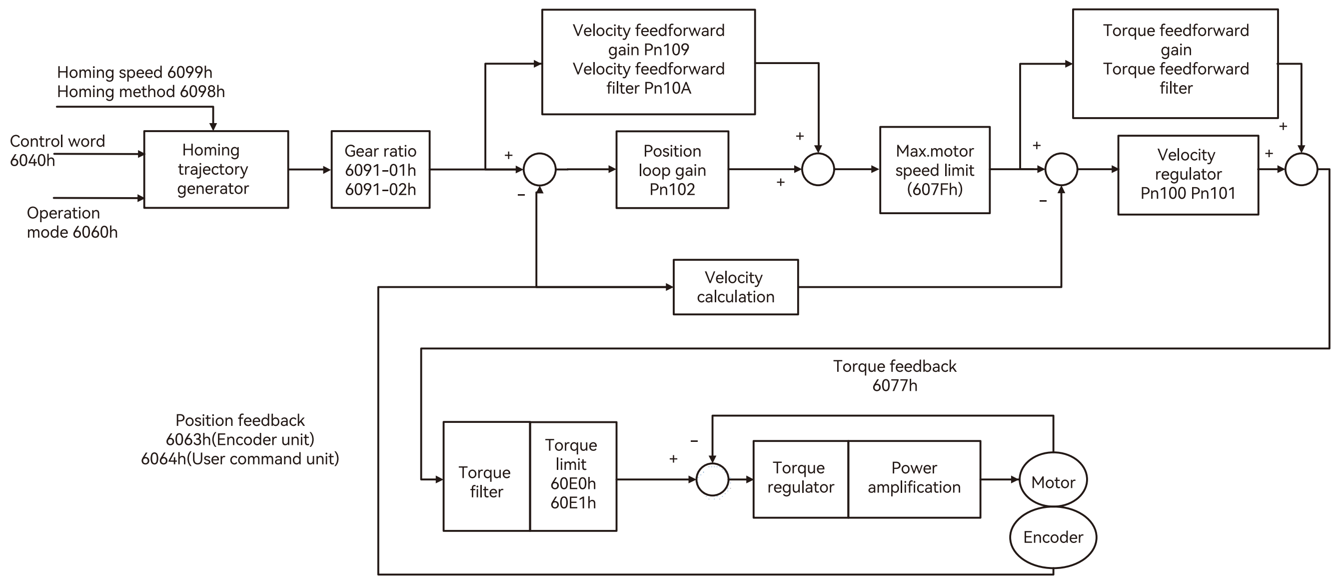


Figure 5-17 Block diagram for home mode

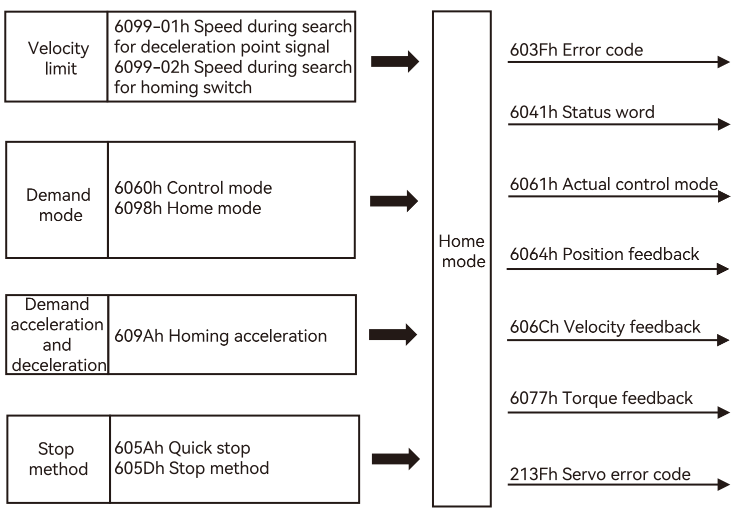


Figure 5-18 Home mode input and output

5.10.1 Control Word in Home Mode (60400010h)

When selecting homing mode, the meaning of each bit of the control word (6040h) is shown in the table below. The bits with dark background are control commands dedicated to homing mode.

Table 5-49 Table 5-53 Description of control word in home mode

Bit	Name	Description
0	Switch on	Must be set to 1 when enable the servo
1	Enable voltage	Must be set to 1 when enable the servo
2	Quick stop	Must be set to 1 when enable the servo, if set to 0 then quick stop
3	Operation enable	Must be set to 1 when enable the servo
4	Home enable	0: Disabled, 1: Enabled. When enabled the homing is started. If switch to disabled then stop the homing process.
5, 6	Reserved for home mode	-

7	Fault reset	When 0 → 1 executes alarm reset for once. If multiple resets are required, multiple changes from 0 → 1 are required. When it is set to 1, other control reference is disabled.
8	Halt	0: disabled, 1: enabled. When enabled the operation is halted.
9	Reserved for home mode	-
10	Reserved	-
11~15	Customized	-

5.10.2 Status word in home mode (60410010h)

When selecting homing mode, the meaning of each bit of the status word (6041h) is shown in the table below. The bits with dark background are statuses dedicated to homing mode.

Table 5-50 Description of status word in home mode

Bit	Name	Description
0	Ready to switch on	0: Disabled, 1: Enabled. When enabled it indicates servo can be enabled
1	Switched on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
2	Operation enabled	0: Disabled, 1: Enabled. When enabled it indicates servo has been enabled
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disabled, 1: Enabled. When enabled it indicates servo can be enabled
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Disabled, 1: Enabled. When enabled it indicates servo cannot be enabled
7	Warning	0: No warning, 1: Warning
8	Customized	-
9	Remote	0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled.
10	Target position reached	60400010h bit 8 (Halt)=0, 0: Position is not reached, 1: Position is reached; 60400010h bit 8 (Halt)=1, 0: Decelerating, 1: Velocity is 0
11	Internal software limit active	0: Software limit position is not reached. 1: Sotware limit position is reached
12	Homing complete output	0: Homing is not completed, 1: Homing is completed
13	Homing error	0: No error, 1: Homing error
14	Customized	-
15	Homing completed	0: Disabled, 1: Homing has been completed. For absolute system, after setting Pn781.3=1, Bit15 value will be saved after homing is completed(retained when power failure)

5.10.3 Related parameter of home mode

As shown in the table below, the object dictionaries involved in homing mode are listed.

Table 5-51 Object dictionaries related to homing mode

Index	Subindex	Signal	Access	Data type	Default value
603Fh	—	Error code	ro	unsigned16	0
6040h	—	Control word	rw	unsigned16	0
6041h	—	Status word	ro	unsigned16	0
6060h	—	Control mode	rw	integer8	0
6061h	—	Control mode display	ro	integer8	0

6062h	—	User position reference	ro	integer32	0
6063h	—	Motor position feedback	ro	integer32	0
6064h	—	User position feedback	ro	integer32	0
6065h	—	User position offset threshold	rw	unsigned32	0
6067h	—	Position reaching threshold	rw	unsigned32	50
6068h	—	Position reaching time	rw	unsigned16	0
606Bh	—	User velocity value	ro	integer32	0
606Ch	—	Actual velocity feedback	ro	integer32	0
607Ch	—	Home offset	rw	integer32	0
607Dh	01h	Software position limit: min position limit	rw	integer32	-2147483648
	02h	Software position limit: max position limit	rw	integer32	2147483647
6098h	—	Home mode	rw	integer8	0
6099h	01h	Speed during search for deceleration point signal	rw	unsigned32	50000
	02h	Speed during search for switch	rw	unsigned32	10000
609Ah	—	Homing acceleration	rw	unsigned32	1000

5.10.4 Simple tutorial for home mode

I. Parameter setting in servo drive

Table 5-52 Parameter of servo drive for operating home mode

Parameter	Set value	Description
Pn002.2	1	Take absolute encoder as incremental. No need to change the parameter in absolute system.
Pn00B.2	1	Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter.

II. The host controller connects to servo drive and set configuration PDO parameters.

III. Run the host controller.

Table 5-53 Home mode startup and operation

Address	Name	Value setting (decimal value)
60600008h	Control mode	6
60980008h	Home mode	1~35
60400010h Control word	Alarm clear	Any number → 128(Enabled on rising edge)
	Homing	6 → 7 → 15 → 31(Always 31 when homing)
60990120h	Speed during search for deceleration point signal	0~3000rpm
60990220h	Speed during search for switch	0~3000rpm
609A0020h	Homing acceleration	0~1000rpm

5.10.5 Home mode introduction

CiA402 internally defines 31 kinds of methods for homing (applicable for EtherCAT), which is shown blew.

In the following description, HSW represents the signal of the origin position sensor, NL represents the negative limit signal, and PL represents the positive limit signal. ON indicates the enabled status of the signal, and OFF indicates the disabled status of the signal. OFF → ON means the transition edge of the signal from enabled status to disabled status, ON → OFF means the transition edge of the signal from enabled status to disabled status. The following introduces the running tracks and signal status changes of various home modes respectively. The meanings of the icons in the diagrams of various homing modes are shown in Figure 5-19:

Table 5-54 Home mode startup and operation

Homing method Description	Description
0	No homing
1	Homing starts in negative direction. Change to low speed when encounter OFF → ON status of NL and then go back to find nearest Z pulse position as the origin.
2	Homing starts in positive direction. Change to low speed when encounter OFF → ON status of PL and then go back to find nearest Z pulse position as the origin.
3	If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter ON → OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin.
4	If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter OFF → ON status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin.
5	If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter ON → OFF status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin.
6	If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter ON → OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin.
7	If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter ON → OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin.
8	If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter OFF → ON status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin.
9	Homing always starts in positive direction no matter HSW is inactive or active. Change to low speed when encounter OFF → ON status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin.
10	Homing always starts in positive direction no matter HSW is inactive or active. Change to low speed when encounter ON → OFF status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin.
11	If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter ON → OFF status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin.
12	If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter OFF → ON status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin.
13	Homing always starts in negative direction no matter HSW is inactive or active. Change to low speed when encounter OFF → ON status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin.
14	Homing always starts in negative direction no matter HSW is inactive or active. Change to low speed when encounter ON → OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin.
15	Reserved
16	Reserved

17	Similar to Method 1, but not to find Z pulse position. The position when encountering OFF → ON status of NL as origin in negative direction.
18	Similar to Method 2, but not to find Z pulse position. The position when encountering OFF → ON status of PL as origin in positive direction.
19	Similar to Method 3, but not to find Z pulse position. The position when encountering ON → OFF status of HSW as origin in negative direction.
20	Similar to Method 4, but not to find Z pulse position. The position when encountering OFF → ON status of HSW as origin in positive direction.
21	Similar to Method 5, but not to find Z pulse position. The position when encountering ON → OFF status of HSW as origin in positive direction.
22	Similar to Method 6, but not to find Z pulse position. The position when encountering OFF → ON status of HSW as origin in negative direction.
23	Similar to Method 7, but not to find Z pulse position. The position when encountering ON → OFF status of HSW as origin in negative direction.
24	Similar to Method 8, but not to find Z pulse position. The position when encountering OFF → ON status of HSW as origin in positive direction.
25	Similar to Method 9, but not to find Z pulse position. The position when encountering OFF → ON status of HSW as origin in negative direction.
26	Similar to Method 10, but not to find Z pulse position. The position when encountering ON → OFF status of HSW as origin in positive direction.
27	Similar to Method 11, but not to find Z pulse position. The position when encountering ON → OFF status of HSW as origin in positive direction.
28	Similar to Method 12, but not to find Z pulse position. The position when encountering OFF → ON status of HSW as origin in negattive direction.
29	Similar to Method 13, but not to find Z pulse position. The position when encountering OFF → ON status of HSW as origin in posititve direction.
30	Similar to Method 14, but not to find Z pulse position. The position when encountering ON → OFF status of HSW as origin in negative direction.
31	Reserved
32	Reserved
33	After starting, find the nearest Z pulse position in negative direction
34	After starting, find the nearest Z pulse position in positive direction
35	Set the current position as origin
36	When not enabled, set the current position as origin

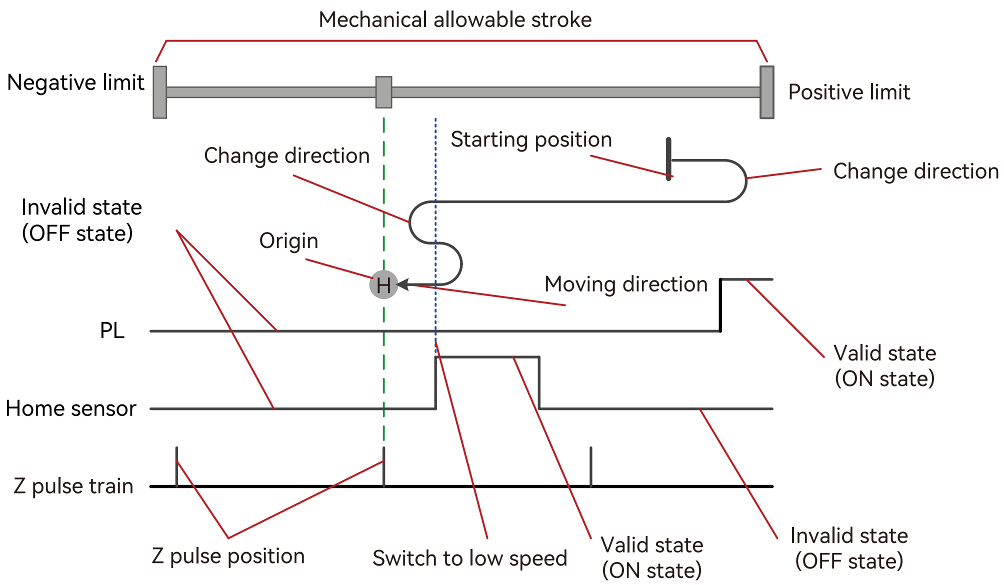


Figure 5-19 Meaning of icons in home mode

In general, it is recommended to apply home mode 3~6, 19~22 to the situation where OFF/ON status of HSW just divided the entire mechanical allowable travel range into two parts. Because in these 8 modes, whenever NL or PL is encountered, operation will stop and alarm and not automatically search for the origin in reverse

It is recommended to apply home mode 7~14, 23~30 to the whole mechanical allowable travel range which is exactly just the range of HSW ON status.

In the case where the travel range is divided into three parts, the range of ON status only occupies only a small part of the whole allowable travel range (ON status is transient)

The above is just suggestion and not mandatory.

I. Mode 1, find negative limit switch and Z pulse, deceleration point: reverse overtravel switch

Starts in negative direction at high speed if deceleration point signal is inactive. Decelerate to stop after encountering OFF → ON status of negative limit switch and running in positive direction at a low speed. After encountering ON → OFF status of negative limit switch, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if deceleration point signal is active. After encountering ON → OFF status of negative limit switch, keep running in positive direction to find the nearest Z pulse position as the origin.

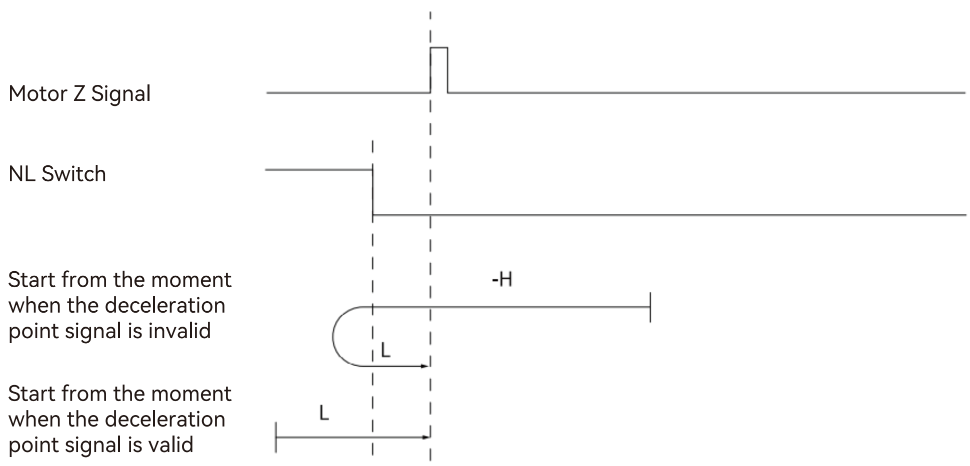


Figure 5-20 Home mode 1 trajectory and signal status

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II. Mode 2, find positive limit switch and Z pulse, deceleration point: positive overtravel switch

Starts in positive direction at high speed if deceleration point signal is inactive. Decelerate to stop after encountering OFF → ON status of positive limit switch and running in negative direction at a low speed. After encountering ON → OFF status of positive limit switch, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if deceleration point signal is active. After encountering ON → OFF status of positive limit switch, keep running in negative direction to find the nearest Z pulse position as the origin.

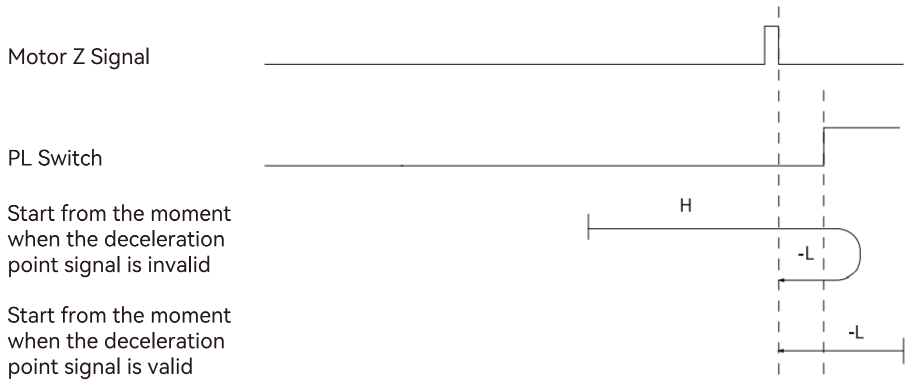


Figure 5-21 Home mode 2 trajectory and signal status

III. Mode 3, find HW ON→OFF position when running in negative direction and Z pulse, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, keep running in negative direction to find the nearest Z signal position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON → OFF status of positive limit switch, keep running in negative direction to find the nearest Z pulse position as the origin.

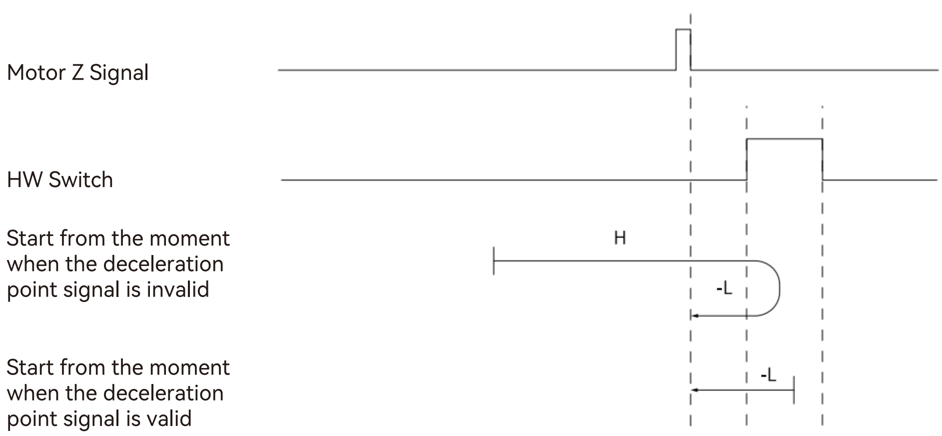


Figure 5-22 Home mode 3 trajectory and signal status

IV. Mode 4, find HW OFF→ON position when running in positive direction and Z pulse, deceleration point: Home switch

Starts in positive direction at a low speed if HW is inactive. After encountering OFF → ON status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is active. Decelerate to stop after encountering ON → OFF status of HW and running in positive direction at a low speed. After encountering OFF → ON status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

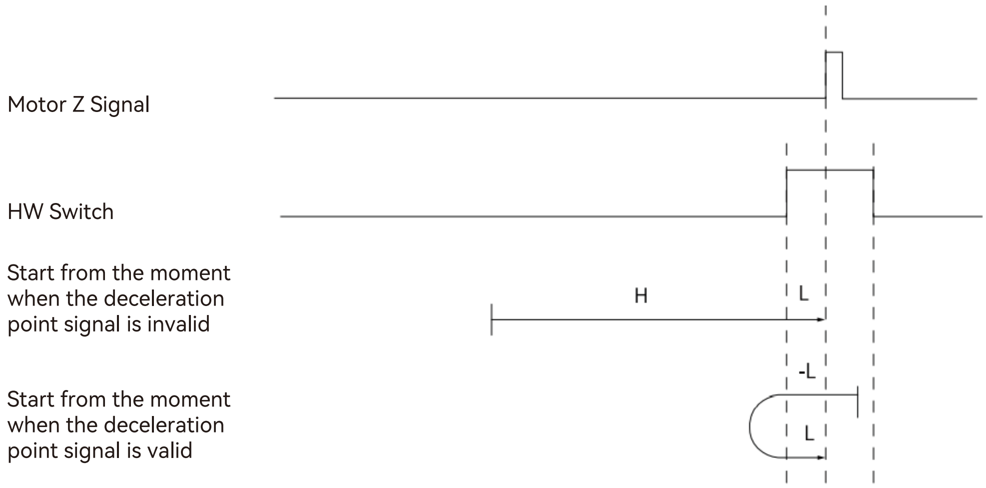


Figure 5-23 Home mode 4 trajectory and signal status

V. Mode 5, find HW ON→OFF position when running in positive direction and Z pulse, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin

Starts in positive direction at a low speed if HW is active. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

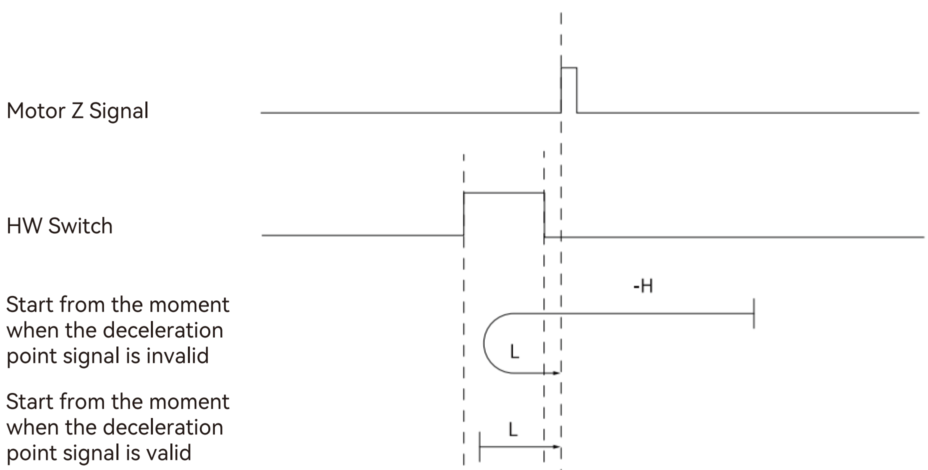


Figure 5-24 Home mode 5 trajectory and signal status

VI. Mode 6, find HW OFF→ON position when running in negative direction and Z pulse, deceleration point: Home switch

Starts in negative direction at a low speed if HW is inactive. After encountering OFF → ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is active. Decelerate to stop after encountering ON → OFF status of HW and running in negative direction at a low speed. After encountering OFF → ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

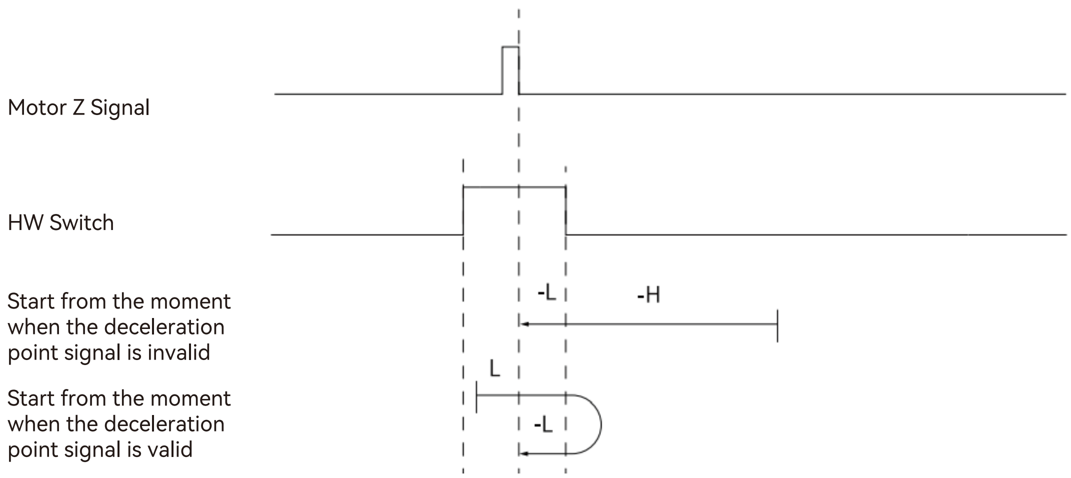


Figure 5-25 Home mode 6 trajectory and signal status

VII. Mode 7, find HW ON→OFF position when running in negative direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON → OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

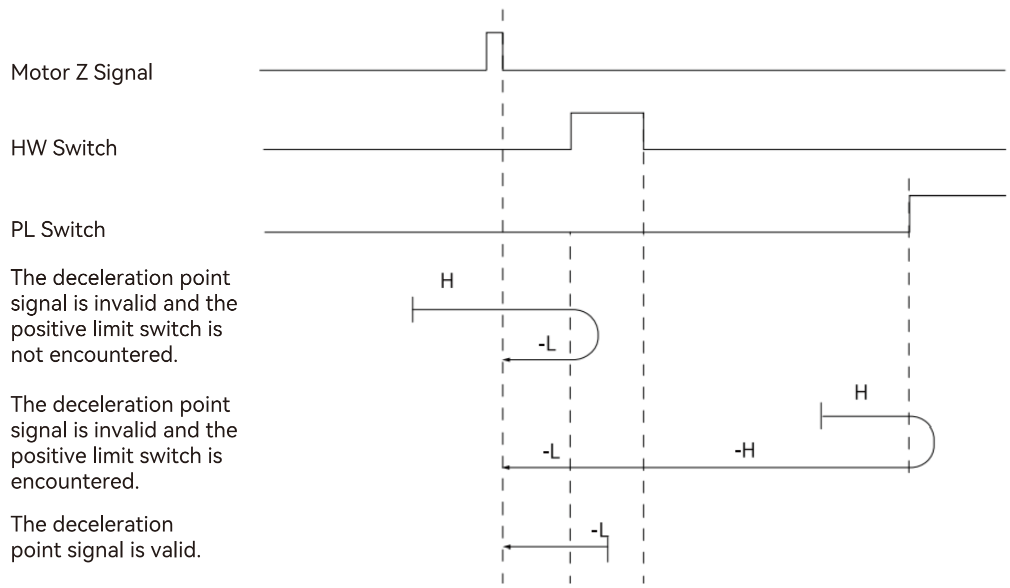


Figure 5-26 Home mode 7 trajectory and signal status

E • Basic Function of Servo

VIII. Mode 8, find HW OFF→ON position when running in positive direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, decelerates to stop and running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, decelerates to stop and running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON → OFF status of HW, decelerate to stop and running in positive direction. After encounter OFF → ON status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

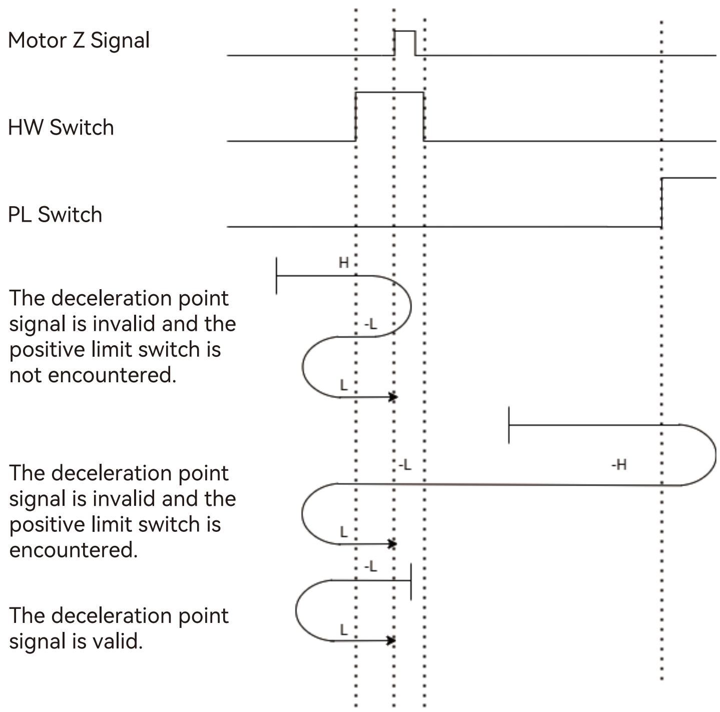


Figure 5-27 Home mode 8 trajectory and signal status

E • Basic Function of Servo

IX. Mode 9, find HW OFF→ON position when running in negative direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, decelerates to stop and running in negative direction. After encountering OFF → ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, decelerates to stop and running in negative direction at a low speed. After encountering OFF → ON of HW, running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON → OFF status of HW, decelerate to stop and running in negative direction. After encounter OFF → ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

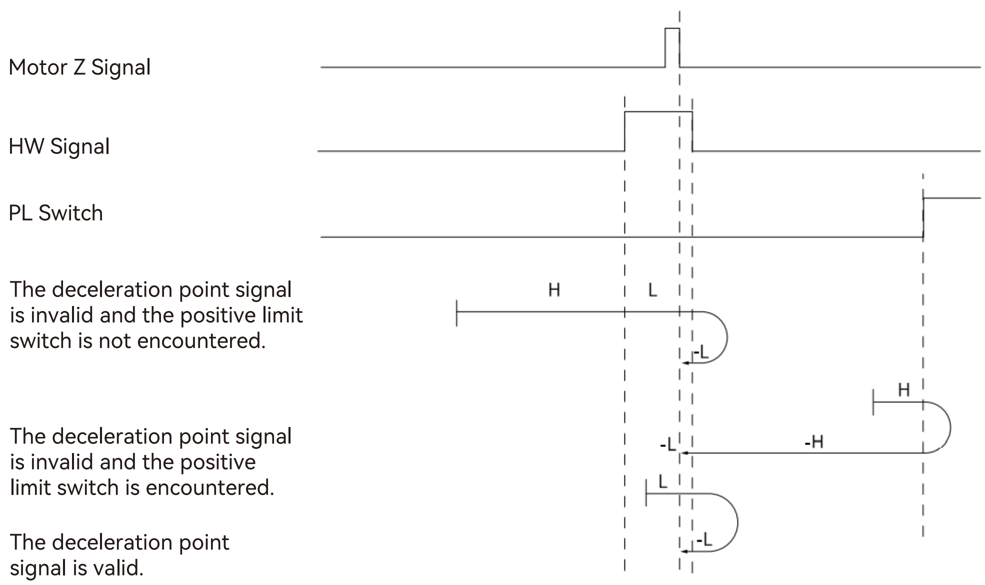


Figure 5-28 Home mode 9 trajectory and signal status

X. Mode 10, find HW ON→OFF position when running in positive direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

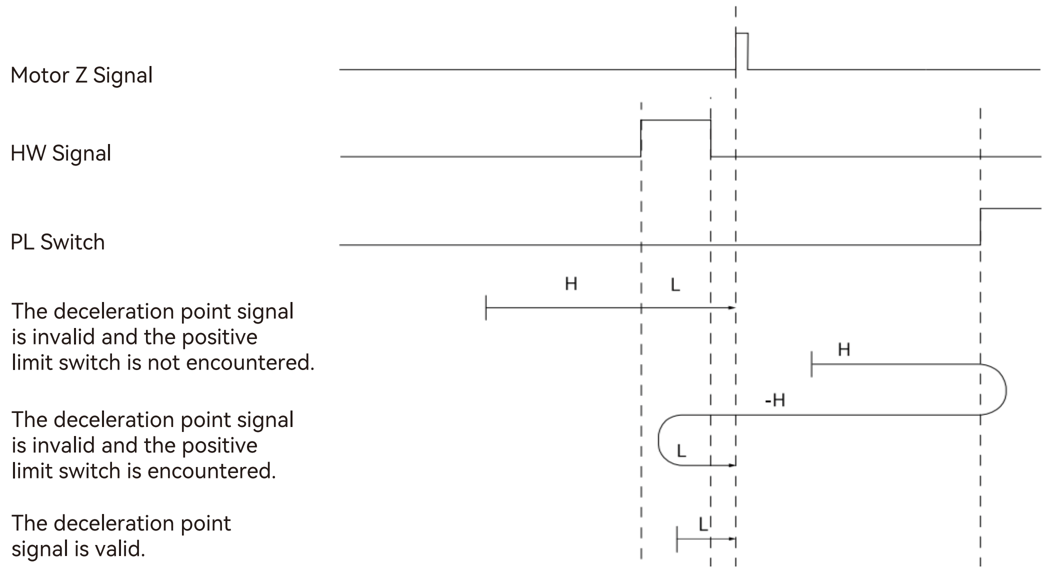


Figure 5-29 Home mode 10 trajectory and signal status

E • Basic Function of Servo

XI. Mode 11, find HW ON→OFF position when running in positive direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON → OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

As shown in the figure below.

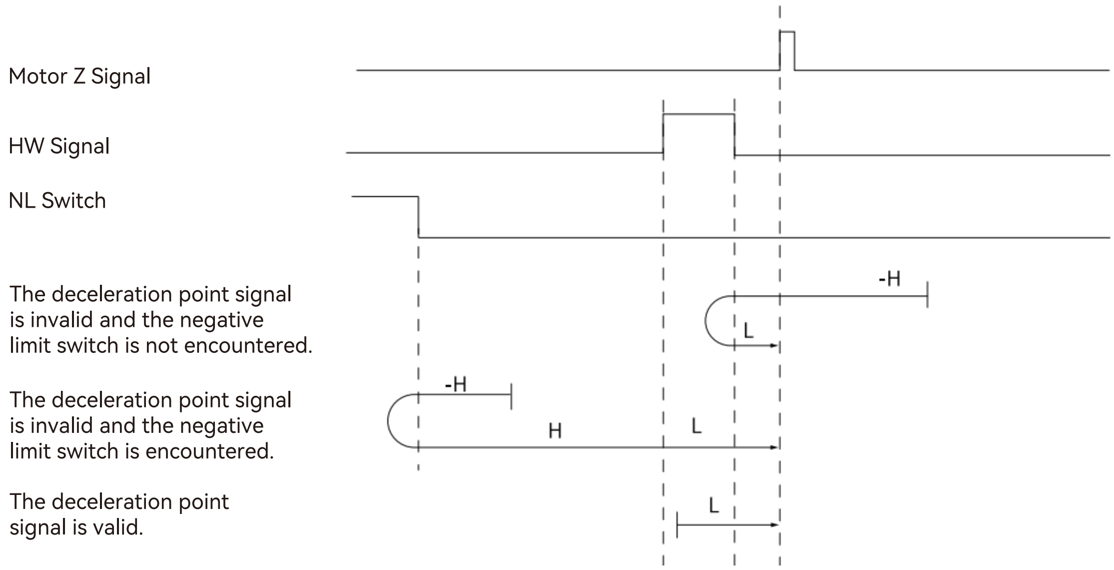


Figure 5-30 Home mode 11 trajectory and signal status

XII. Mode 12, find HW OFF→ON position when running in negative direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, decelerate to stop and running in negative direction. After encountering OFF → ON of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at a low speed. After encountering ON → OFF status of HW, decelerate to stop and running in negative direction at a low speed. After encountering OFF → ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON → OFF status of HW and running in negative direction at a low speed. After encountering OFF → ON of HW, keep running in negative direction to find the nearest Z pulse position as the origin. As shown in the figure below.

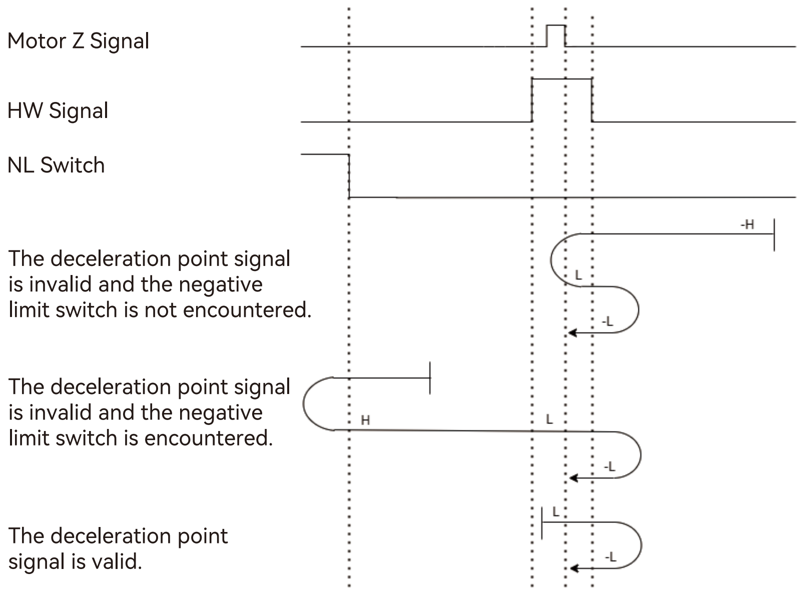


Figure 5-31 Home mode 12 trajectory and signal status

XIII. Mode 13, find HW OFF→ON position when running in positive direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, decelerate to stop and running in positive direction. After encountering OFF → ON of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, decelerate and running in negative direction at a low speed. After encountering OFF → ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON → OFF status of HW and running in positive direction at a low speed. After encountering OFF → ON of HW, keep running in positive direction to find the nearest Z pulse position as the origin. As shown in the figure below.

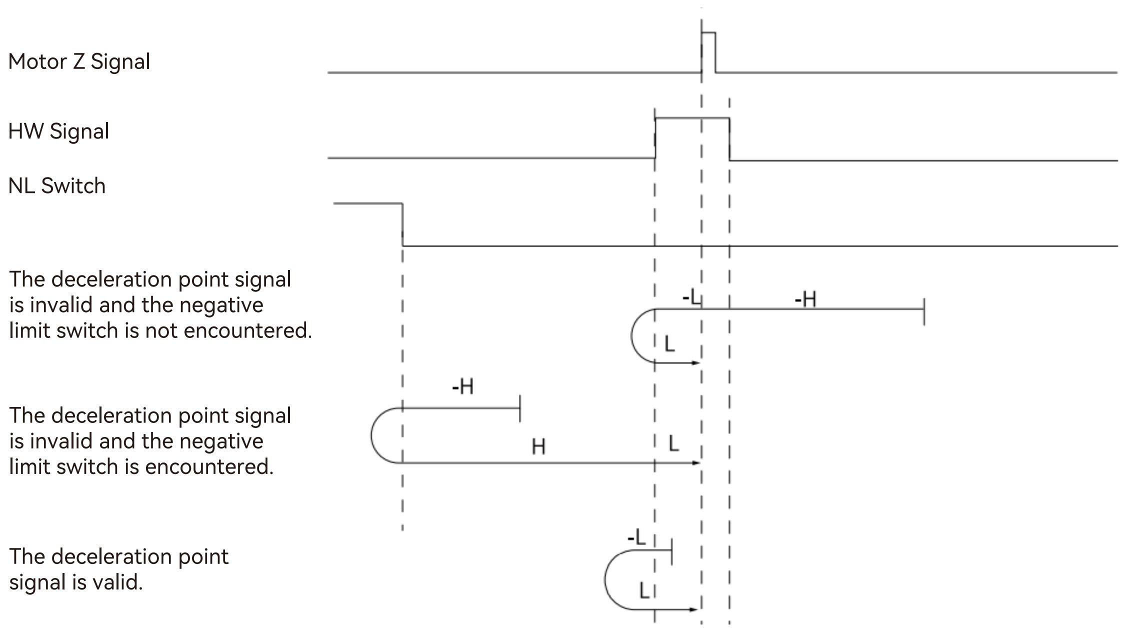


Figure 5-32 Home mode 13 trajectory and signal status

E • Basic Function of Servo

XIV. Mode 14, find HW ON→OFF position when running in negative direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, decelerate to stop and running in positive direction. After encountering OFF → ON of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON → OFF status of HW, keep running in negative direction at a low speed. As shown in the figure below.

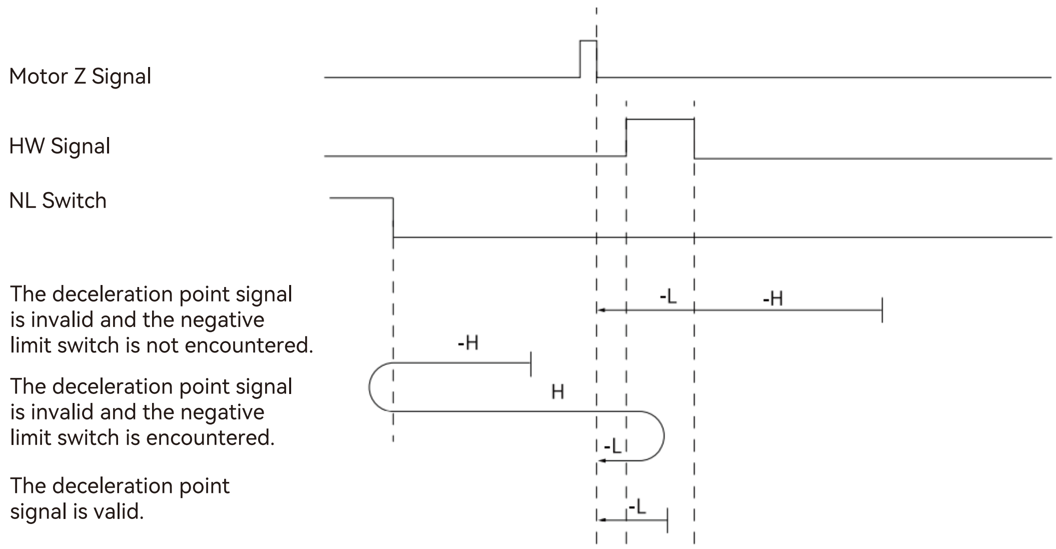


Figure 5-33 Home mode 14 trajectory and signal status

XV. Mode 15, reserved, please do not set.

XVI. Mode 16, reserved, please do not set.

XVII. Mode 17, find negative limit switch, deceleration point: reverse overtravel switch

Starts in negative direction at high speed if negative limit switch is inactive. Decelerate to stop after encountering OFF → ON status of negative limit switch and running in positive direction at a low speed. After encountering ON → OFF status of negative limit switch, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if negative limit switch is active. Decelerate to stop after encountering ON → OFF status of negative limit switch and the stop position is the origin.

As shown in the figure below. Refer to Table 5-51.

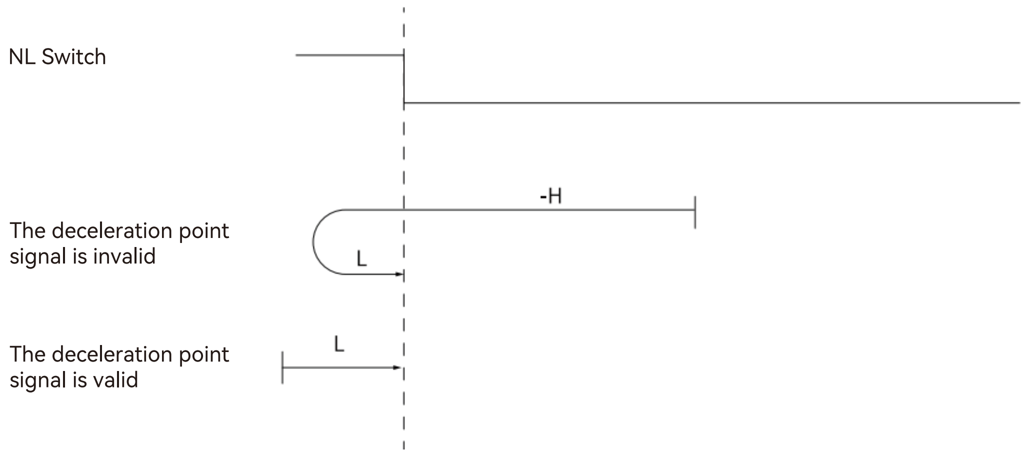


Figure 5-34 Origin mode 17 trajectory and signal status

XVIII. Mode 18, find positive limit switch, deceleration point: Overtravel switch

Starts in positive direction at high speed if positive limit switch is inactive. Decelerate to stop after encountering OFF → ON status of positive limit switch and running in negative direction at a low speed. After encountering ON → OFF status of negative limit switch, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if positive limit switch is active. Decelerate to stop after encountering ON → OFF status of positive limit switch and the stop position is the origin. As shown in the figure below.

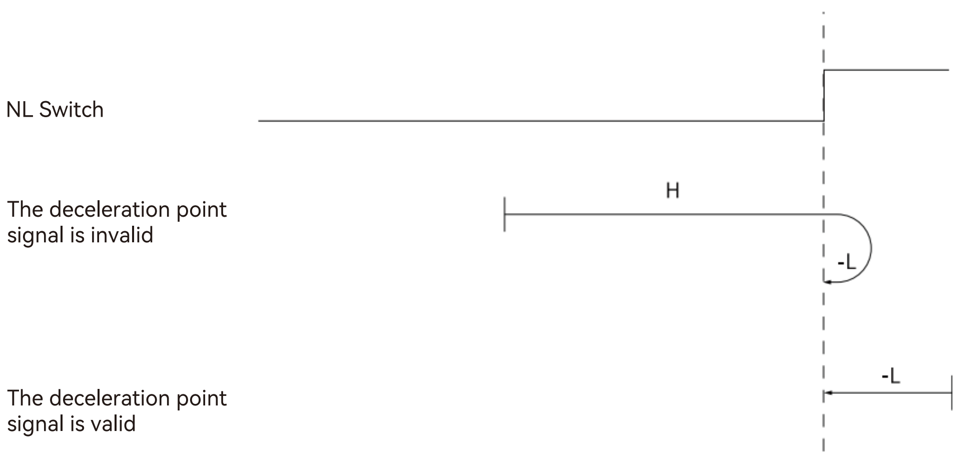


Figure 5-35 Home mode 18 trajectory and signal status

XIX. Mode 19, find home switch ON→OFF position when running in negative direction, deceleration point: home switch

Starts in positive direction at high speed if HW is inactive. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at a low speed. After encountering ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is active. Decelerate to stop after encountering ON → OFF status of HW and the stop position is the origin.

As shown in the figure below.

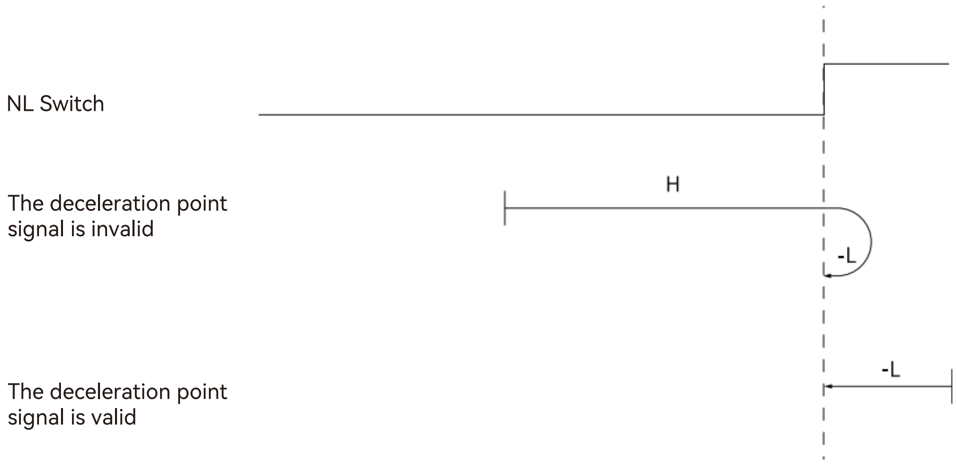


Figure 5-36 Home mode 19 trajectory signal and status

XX. Mode 20, find home switch OFF→ON position when running in positive direction, deceleration point: home switch

Starts in positive direction at low speed if HW is inactive. Decelerate to stop after encountering OFF → ON status of HW and the stop position is the origin.

Starts in negative direction at high speed if HW is active. Decelerate to stop after encountering ON → OFF status of HW and running at a low speed in positive direction. After encountering OFF → ON status of HW, decelerate to strop and the stop position is the origin. As shown in the figure below.

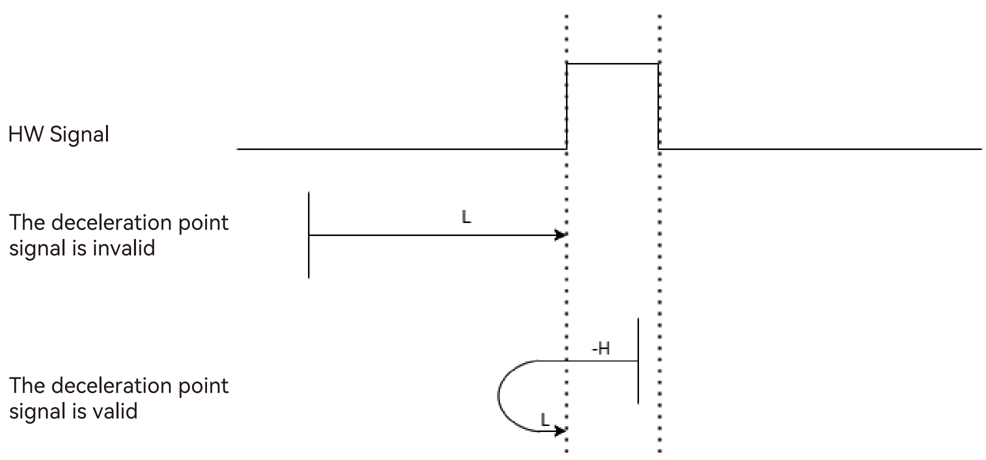


Figure 5-37 Home mode 20 trajectory signal and status

E • Basic Function of Servo

XXI. Mode 21, find home switch ON→OFF position when running in positive direction, deceleration point: home switch

Starts in negative direction at high speed if HW is inactive. Decelerate to stop after encountering OFF → ON status of HW and running at low speed in positive direction. After encountering ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop after encountering ON → OFF status of HW and the stop position is the origin. As shown in the figure below.

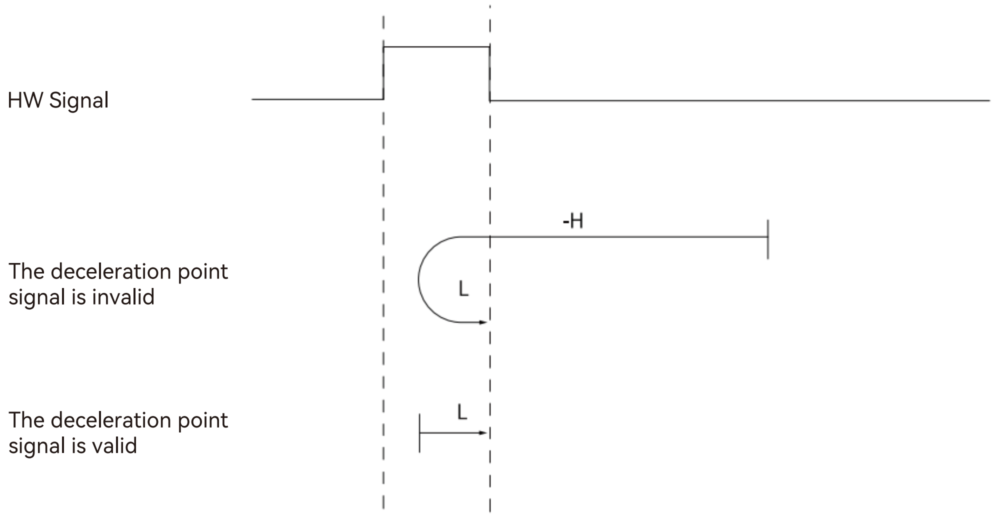


Figure 5-38 Home mode 21 trajectory signal and status

XXII. Mode 22, find home switch OFF→ON position when running in negative direction, deceleration point: home switch

Starts in negative direction at low speed if HW is inactive. Decelerate to stop after encountering OFF → ON status of HW and the stop position is the origin.

Starts in positive direction at high speed if HW is active. Decelerate to stop after encountering ON → OFF status of HW and running in negative direction at low speed. After encountering the OFF → ON status of HW, decelerate to stop the stop position is the origin. As shown in the figure below.

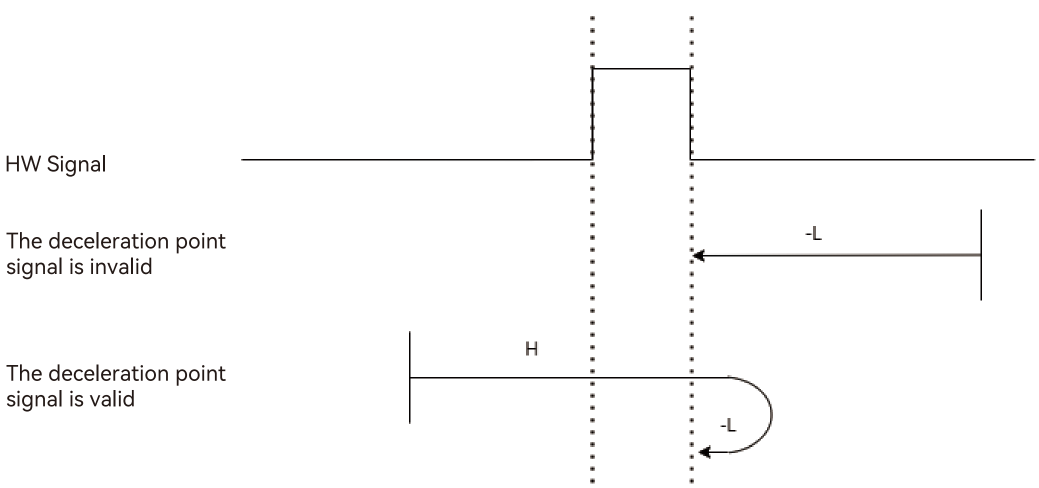


Figure 5-39 Home mode 22 trajectory signal and status

E • Basic Function of Servo

XXIII. Mode 23, find home switch OFF→ON position when running in negative direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction if HW is active. Decelerate to stop after encountering ON → OFF status of HW and the stop position is the origin. As shown in the figure below.

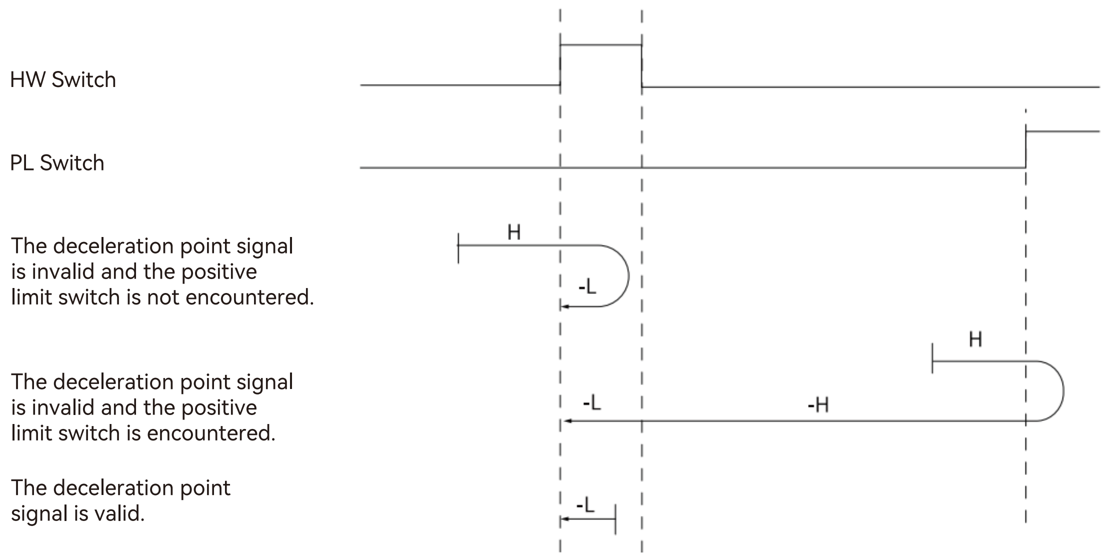


Figure 5-40 Home mode 23 trajectory and signal status

E • Basic Function of Servo

XXIV. Mode 24, find home switch OFF→ON position when running in positive direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and running in positive direction at low speed. After encountering the OFF → ON status, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and running in positive direction at low speed. After encountering the OFF → ON status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if HW is active. Decelerate to stop and running in positive direction after encountering ON → OFF status of HW. After encountering OFF → ON status of HW, decelerate to stop and the stop position is the origin. As shown in the figure below.

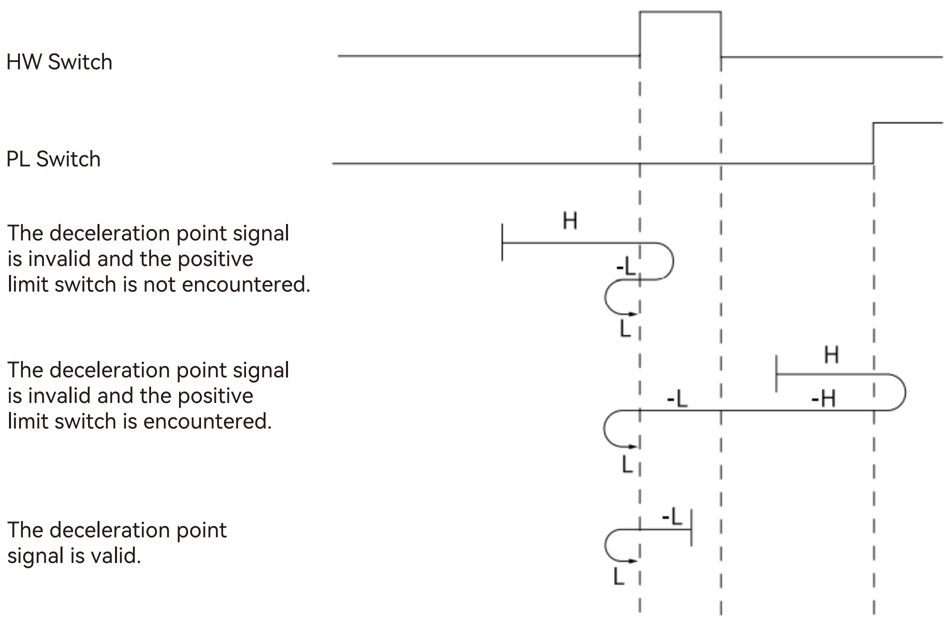


Figure 5-41 Home mode 24 trajectory and signal status

XXV.Mode 25, find home switch OFF→ON position when running in negative direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and running in negative direction at low speed. After encountering the OFF → ON status, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and running in negative direction at low speed. After encountering the OFF → ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and running in positive direction after encountering ON → OFF status of HW. After encountering OFF → ON status of HW, decelerate to stop and the stop position is the origin. As shown in the figure below.

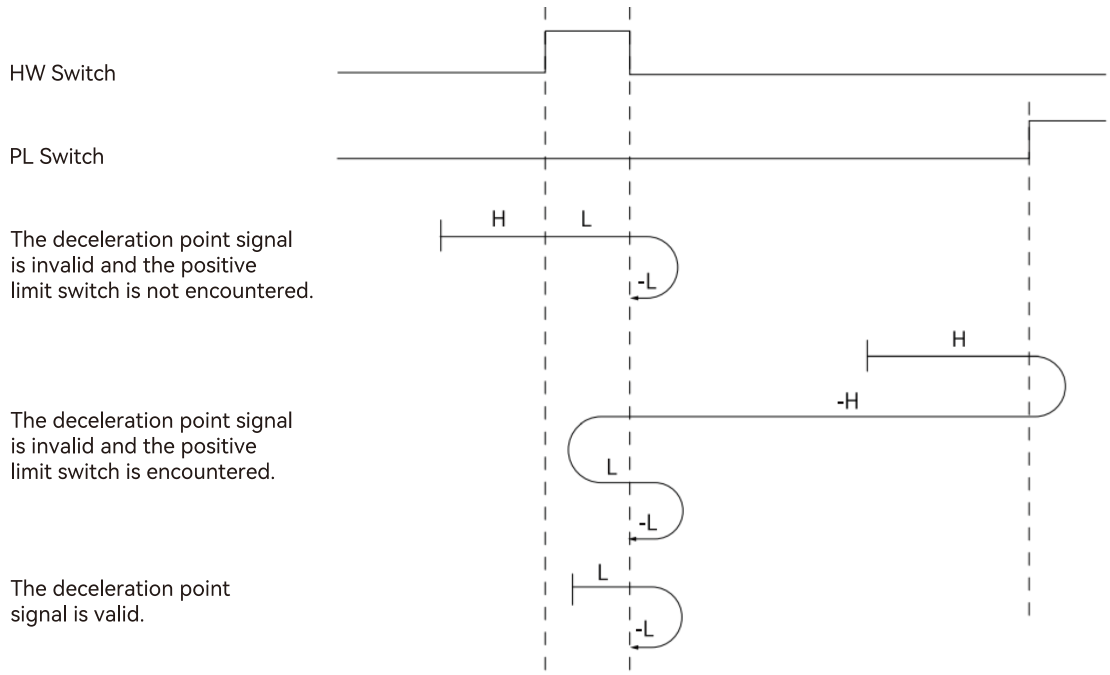


Figure 5-42 Home mode 25 trajectory and signal status

XXVI. Mode 26, find home switch ON→OFF position when running in positive direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and the stop position is the origin after encountering ON → OFF status of HW.

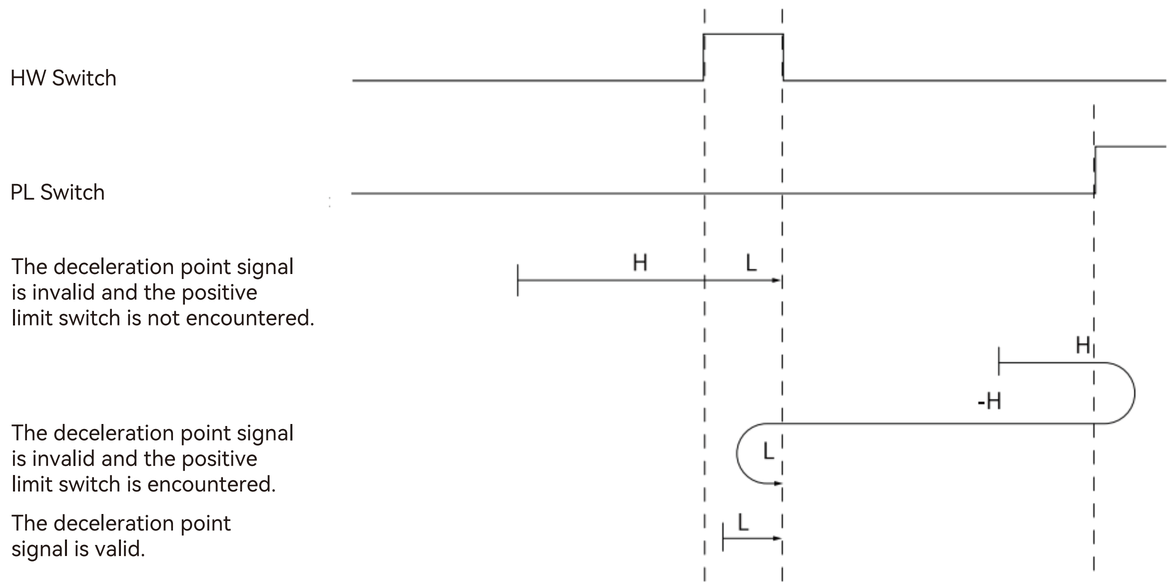


Figure 5-43 Home mode 26 trajectory and signal status

XXVII. Mode 27, find home switch ON→OFF position when running in positive direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and the stop position is the origin after encountering ON → OFF status of HW.

As shown in the figure below.

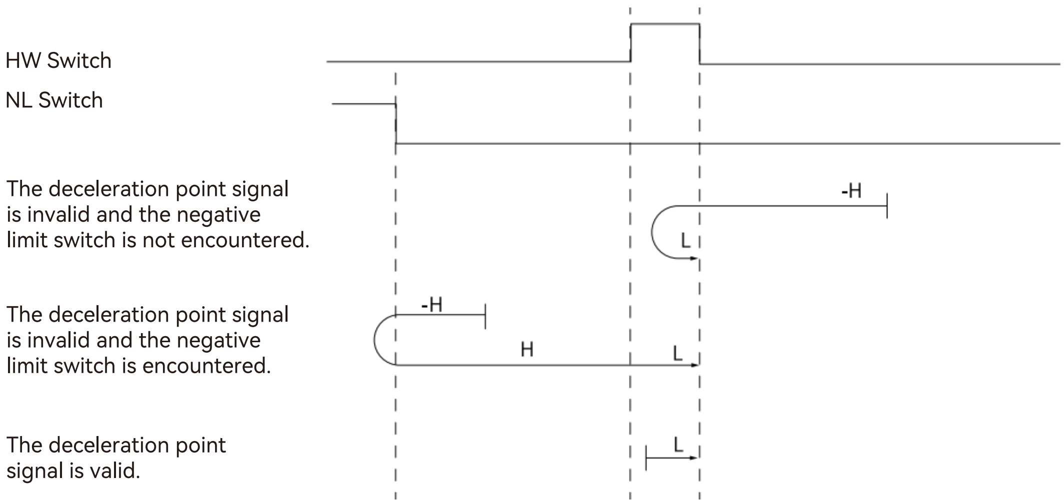


Figure 5-44 Home mode 27 trajectory and signal status

E • Basic Function of Servo

XXVIII.Mode 28, find home switch OFF→ON position when running in negative direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and running in negative direction at low speed. After encountering OFF → ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in positive direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and running in the negative direction at low speed. After ecnountering the OFF → ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and running in the negative direction at low speed after encountering the ON → OFF status of HW. After encountering OFF → ON status of HW, decelerate to stop and the stop position is the origin. As shown in the figure below.

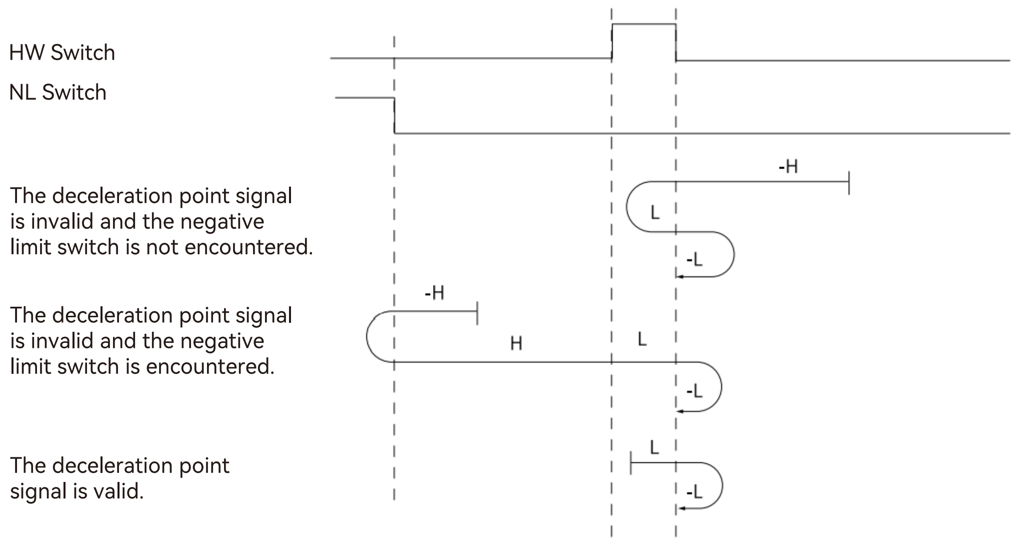


Figure 5-45 Home mode 28 trajectory 28 and signal status

XXIX. Mode 29, find home switch OFF→ON position when running in positive direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and running in positive direction at low speed. After encountering OFF → ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and running in the positive direction at low speed. After ecnountering the OFF → ON status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if HW is active. Decelerate to stop and running in the positive direction at low speed after encountering the ON → OFF status of HW. After encountering OFF → ON status of HW, decelerate to stop and the stop position is the origin. As shown in the figure below.

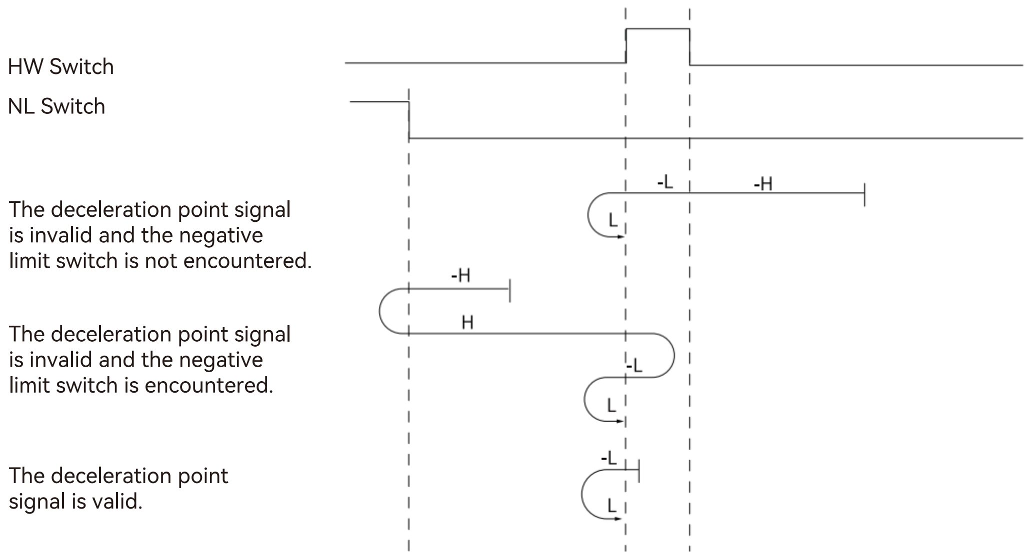


Figure 5-46 Home mode 29 trajectory and signal status

XXX. Mode 30, find home switch OFF→ON position when running in negative direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF → ON status of HW and running in negative direction at low speed. After encountering the ON → OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if HW is active. Decelerate to stop after encountering the ON → OFF status of HW and the stop position is the origin.

As shown in the figure below.

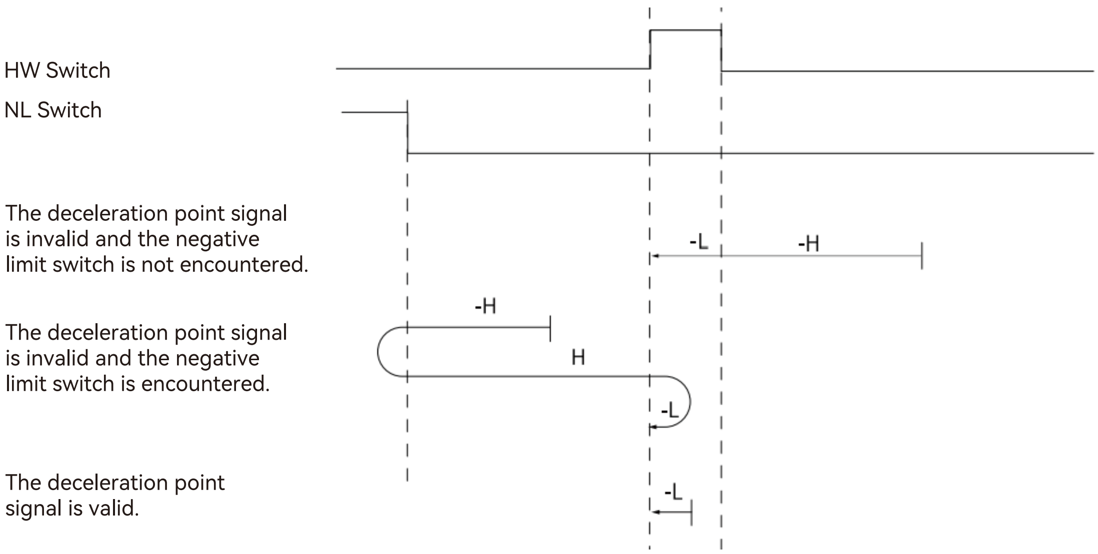


Figure 5-47 Home mode 30 trajectory and signal status

XXXI. Mode 31, reserved, please do not set.

XXXII. Mode 32, reserved, please do not set.

XXXIII. Mode 33, find the nearest Z pulse when running in negative direction.

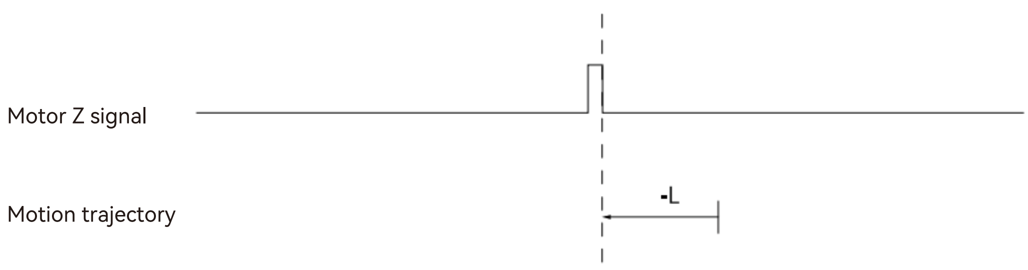


Figure 5-48 Home mode 33 trajectory and signal status

XXXIV.Mode 34, find the nearest Z pulse when running in positive direction

Starts in positive direction at low speed and find the nearest Z pulse as the origin.

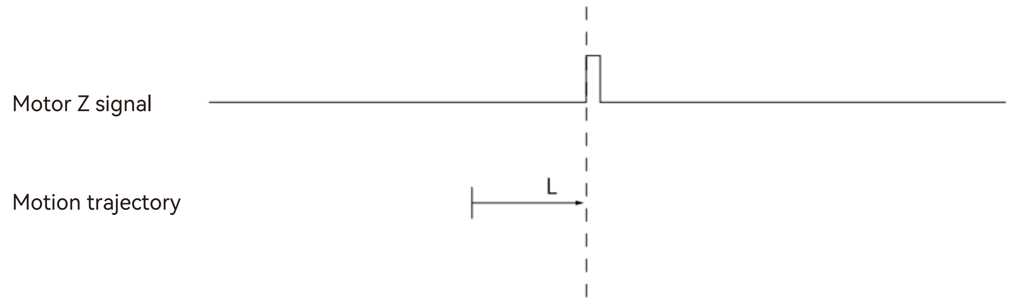


Figure 5-49 Home mode 34 trajectory and signal status

XXXV. Mode 35, set the current position as origin

After triggering homing to zero, set the current position as origin.

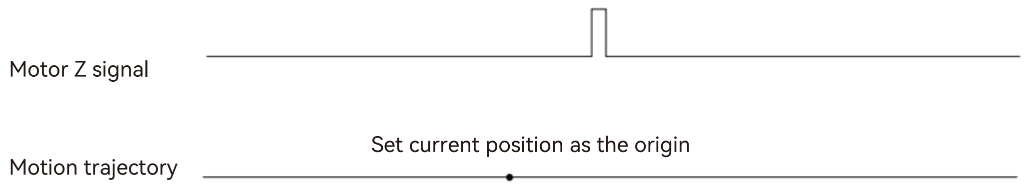


Figure 5-50 Home mode 35 trajectory and signal status

XXXVI. Mode 36, when not enabled, set the current position as the home position

After triggering homing to zero, set the current position as origin.

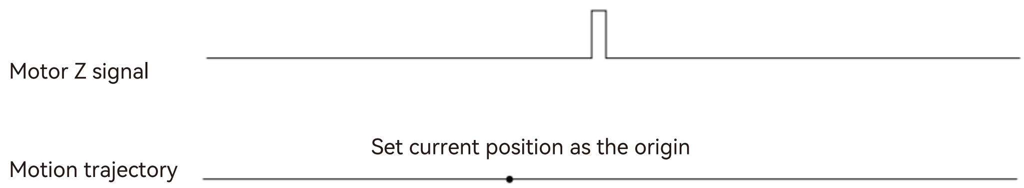


Figure 5-51 Home mode 36 trajectory and signal status

5.10.6 Instructions for using the homing persistent data memory switch

Normally, after a successful homing operation, bit 15 of the status word 6041 is set to 1. After a power-off, it switches to 0. If users need bit 15 of the status word 6041 to remain 1 after a power-off, it is necessary to set Pn781.3.

1. Set Pn781.3 = 1 to enable the homing persistent data memory function.

2. After a successful homing operation, the value of bit 15 of the status word 6041 is stored (saved during power-off).

3. After powering on again, bit 15 of the status word 6041 is 1.

5.11 Cyclic synchronous position mode, CSP

In Cyclic synchronous position mode, host controller is to plan the start velocity and the stop velocity, the acceleration(deceleration) to reach the target position and absolute value of target position in each synchronous cycle. Servo drive follows the target position. To enable CSP mode, set object 6060H to 8. It is available in EtherCAT. The control block diagram and input/output are shown in the following two figures.

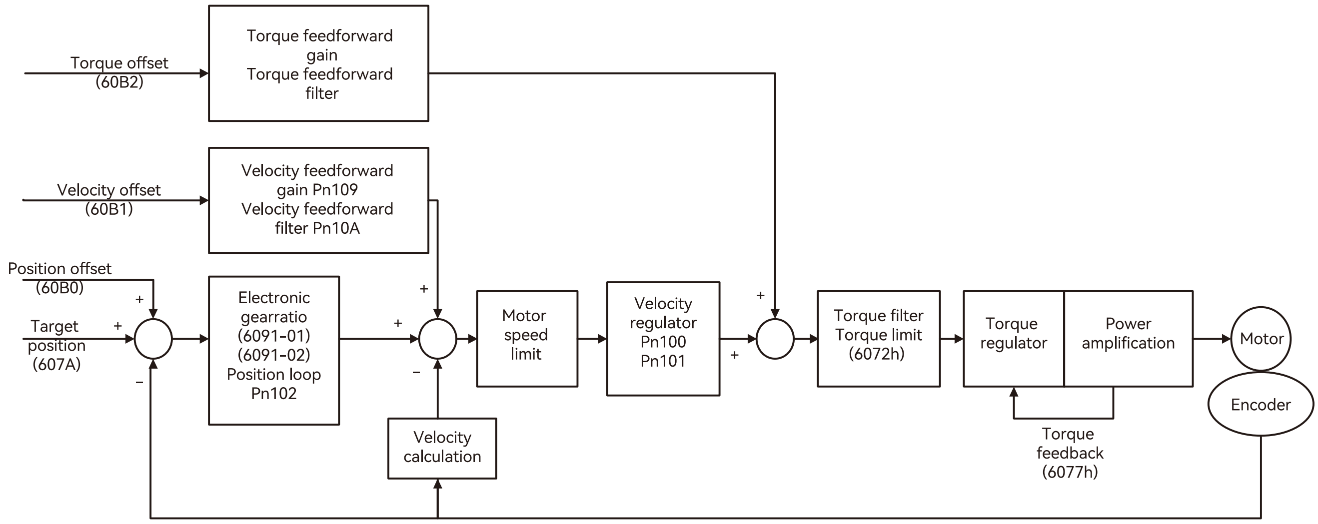


Figure 5-52 Cyclic synchronous position mode block diagram

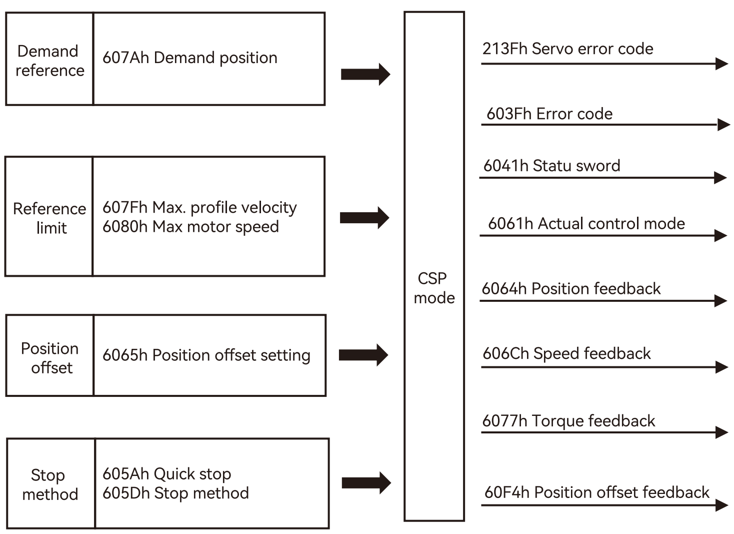


Figure 5-53 Cyclic synchronous position mode input and output

5.11.1 Control word in cyclic synchronous position mode (60400010h)

The meaning of each bit of control word in cyclic synchronous position mode is shown as the table below.

Table 5-55 Description of control word in cyclic synchronous position mode

Bit	Name	Description
0	Switch on	Must be set to 1 when enable the servo
1	Enable voltage	Must be set to 1 when enable the servo
2	Quick stop	Must be set to 1 when enable the servo, if set to 0 then quick stop
3	Operation enable	Must be set to 1 when enable the servo

4 ~ 6	CSP mode reserved	-
7	Fault reset	When 0 → 1 exucutes alarm reset for once. If multiple resets are required, multiple changes from 0 → 1 are required. When it is set to 1, other control reference is disabled.
8	Halt	0: disabled, 1: enabled. When enabled the operation is halted.
9	CSP mode reserved	-
10	Reserved	—
11~15	Customized	-

5.11.2 Status word in cyclic synchronous position mode (60410010h)

The meaning of each bit of status word in cyclic synchronous position mode is shown as table 5-56. The item in dark background indicates the dedicated control reference in cyclic synchronous position mode.

Table 5-56 Description of status word in cyclic synchronous position mode

Bit	Name	Description
0	Ready to switch on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
1	Switched on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
2	Operation enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled.
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
7	Warning	0: No warning, 1: Warning
8	Customized	-
9	Remote	0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled.
10	Position reached	60400010h bit 8 (Halt)=0, 0: Position is not reached, 1: Position is reached; 60400010h bit 8 (Halt)=1, 0: Decelerating,1: Velocity is 0
11	Internal software limit active	0: Software limit position is not reached. 1: Sotware limit position is reached
12	Whether to follow target position	0: Target position is not followed, 1: Target position is followed
13	Alarm for position following offset	0: No position offset alarm, 1: Position offset alarm
14	Customized	-
15	Origin completed	0: Disabled, 1: Homing has been completed. For absolute system, after setting Pn781.3=1, Bit15 value will be saved after homing is completed(retained when power failure)

5.11.3 Related dictionary objects in cyclic synchronous position mode

Table 5-57 Related dictionary objects in cyclic synchronous position mode

Index	Subindex	Signal	Access	Data type	Default value
6040h	—	Control word	rw	unsigned16	0
6041h	—	Status word	ro	unsigned16	0
6060h	—	Control mode	rw	integer8	0
6061h	—	Control mode display	ro	integer8	0

6062h	—	User position reference	ro	integer32	0
6063h	—	Motor position feedback	ro	integer32	0
6064h	—	User position feedback	ro	integer32	0
6065h	—	User position offset	rw	unsigned32	0
6067h	—	Position reaching threshold	rw	unsigned32	0
6068h	—	Position reaching time	rw	unsigned16	0
606Bh	—	User velocity reference	ro	integer32	0
606Ch	—	User velocity feedback	ro	integer32	0
607A	—	Target position	rw	integer32	0
607Ch	—	Home offset	rw	integer32	0
607Dh	01h	Software position limit: min position limit	rw	integer32	-2147483648
	02h	Software position limit: max position limit	rw	integer32	2147483647
6080h	—	Max motor speed	rw	unsigned32	10000
60B0h	—	Position offset	rw	integer32	0
60B1h	—	Velocity offset	rw	integer32	0
60B2h	—	Torque offset	rw	integer32	0
60F4h	—	User position offset	ro	integer32	0
60FCh	—	Motor position feedback	ro	integer32	0

5.11.4 Simple tutorial for cyclic synchronous position mode

I. Set parameter in servo drive

Table 5-58 Servo drive parameter for cyclic synchronous position mode

Parameter	Set value	Description
Pn002.2	1	Take absolute encoder as incremental. No need to change the parameter in absolute system.
Pn00B.2	1	Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter.

II. The host controller connects to servo drive and set the communication parameter(communication of synchronous cycle time, axis parameter, etc.)

III. Run the host controller

Table 5-59 Cyclic synchronous position mode startup and operation

Address	Name	Value setting (decimal value)
60600008h	Control mode	8
60400010h Control word	Enable	Any number → 6 → 7 → 1 or MC_Power
	Alarm clear	Any number → 128 (Enable on rising edge)
	Axis error reset	Set by host controller or by reference MC_Reset from PLC
607A0020h	Demand position	Set by host controller (including acceleration and deceleration, etc.)
	Analog velocity control	Set by host controller, or by reference MC_MoveVelocity from PLC
	Demand relative position	Set by host controller, or by reference MC_ MoveRelative from PLC
	Demand additive postion	Set by host controller, or by reference MC_MoveAdditive from PLC
607A0020h	Demand absolute position	Set by host controller, or by reference MC_MoveAbsolute from PLC
	Axis decelerate to stop	Set by host controller, or by reference MC_Stop from PLC
	Cyclic synchronous time	Set by host controller (DC-SYn-chro)

5.11.5 Positioning completion signal

In position control, it indicates the reference pulse output by the host controller and the current position offset of the servo motor is less than the setting value of Pn522, which is for host controller to confirm the positioning is completed.

Table 5-60 Positioning completion signal input

Type	Name	Connector	Status	Meaning
Input	/COIN	CN1-25, 26	ON (closed)	Positioning is completed
			OFF (open)	Positioning is not completed

Table 5-61 Positioning completion signal parameter setting

Pn78C	Electronic gear ratio numerator		Position	When enabled	Classification
	Setting range	Unit	Default value	After start	Setup
	1-1073741824	—	1		

Note: 1. No effect on final positioning accuracy.

2. If the parameter is set to a value that is too large, the /COIN signal may be output when the position deviation is low during a low-speed operation. Please set this parameter in a reasonable range.

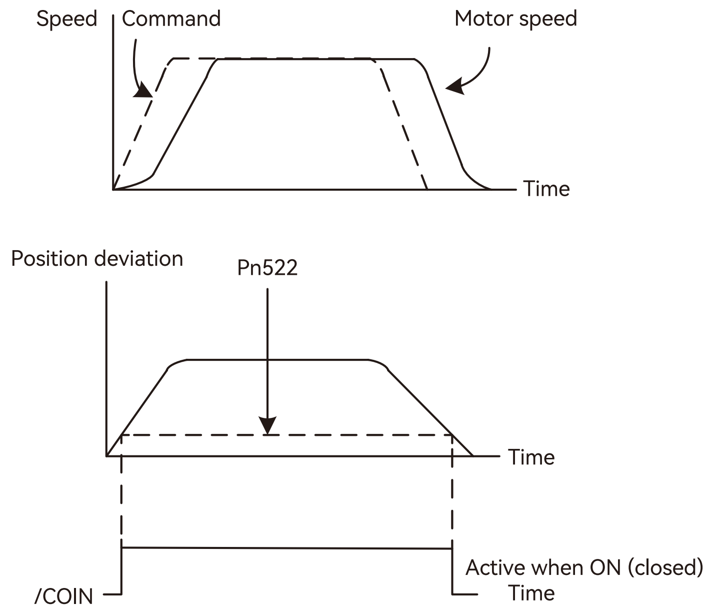


Figure 5-54 /COIN signal output timing chart

If the position deviation is always low and a narrow positioning completed width is used, change the setting of Pn207.3.

Table 5-62 /COIN output timing parameter setting

Parameter		Signal	Meaning	When enabled	Classification
Pn207 (Position control command form selection switch)	n. 0 □□□ (Default value)	/COIN signal output time	Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522	After restart	Setup
	n. 1 □□□		Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 and the command after the position command filter is 0.		
	n. 2 □□□		Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 and the command input is 0.		

5.12 Cyclic synchronous velocity mode, CSV

In Cyclic Synchronous Velocity Mode, the host controller is to plan the acceleration(deceleration) to reach the target velocity and target velocity in each synchronous cycle. Servo drive follows the target velocity. To enable CSV mode, set object 6060H to 9. It is available in EtherCAT. The control block diagram and input/output are shown in the following two figures.

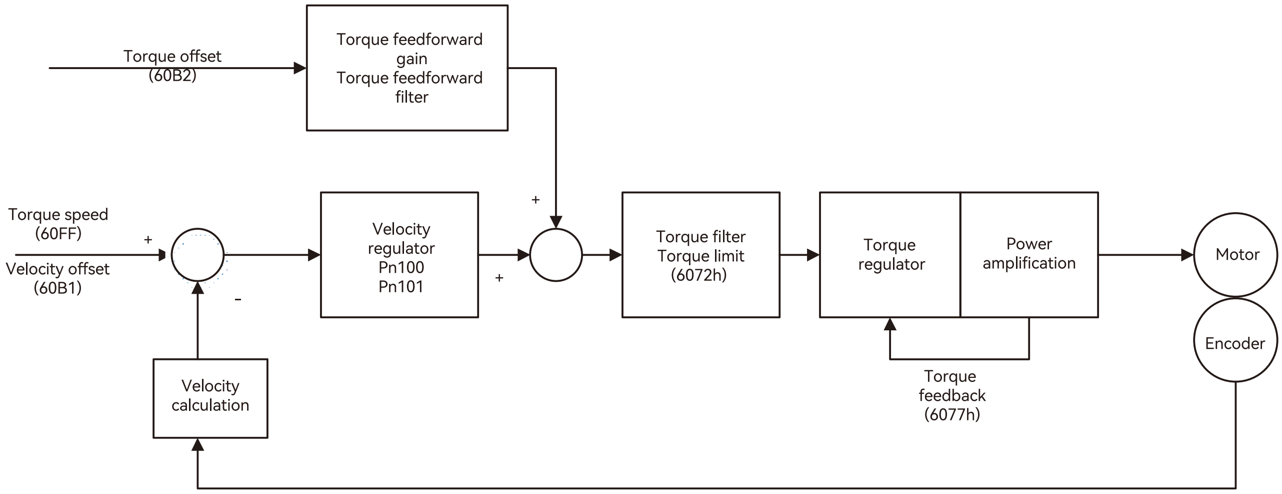


Figure 5-55 Cyclic synchronous velocity mode input and output

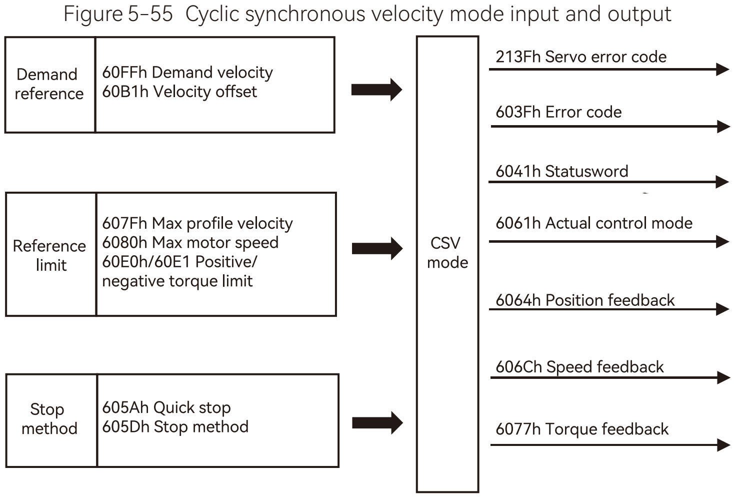


Figure 5-56 Cyclic synchronous velocity mode input and output

5.12.1 Control word in cyclic synchronous velocity mode (60400010h)

The meaning of each bit of control word(6040h) in cyclic synchronous velocity mode is shown as the table below.

Bit	Name	Description
0	Switch on	Must be set to 1 when enable the servo
1	Enable voltage	Must be set to 1 when enable the servo
2	Quick stop	Must be set to 1 when enable the servo, if set to 0 then quick stop
3	Operation enable	Must be set to 1 when enable the servo
4 ~ 6	CSV mode reserved	-
7	Fault reset	When 0 → 1 exucutes alarm reset for once. If multiple resets are required, multiple changes from 0 → 1 are required. When it is set to 1, other control reference is disabled.
8	Halt	0: disabled, 1: enabled. When enabled the operation is halted.
9	CSV mode reserved	-

10	Reserved	-
11~15	Customized	-

5.12.2 Status word in cyclic synchronous velocity mode(60410010h)

The meaning of each bit of status word in cyclic synchronous velocity mode is shown as the table below. The item in dark background indicates the dedicated control reference in cyclic synchronous velocity mode.

Table 5-63 Description of status word in cyclic synchronous velocity mode

Bit	Name	Description
0	Ready to switch on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
1	Switched on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
2	Operation enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled.
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled.
6	Switch on disabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
7	Warning	0: No warning, 1: Warning
8	Customized	-
9	Remote	0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled.
10	CSV mode reserved	-
11	Internal software limit active	0: Software limit position is not reached. 1: Sotware limit position is reached
12	Whether to follow target velocity	0: Target velocity is not followed, 1: Target velocity has been followed.
13	CSV mode reserved	-
14 ~ 15	Customized	-

5.12.3 Related dictionary objects in cyclic synchronous velocity mode

Table 5-64 Related dictionary objects in cyclic synchronous velocity mode

Index	Subindex	Signal	Access	Data type	Default value
603Fh	—	Error code	ro	unsigned16	0
6040h	—	Control word	rw	unsigned16	0
6041h	—	Status word	ro	unsigned16	0
6060h	—	Control mode	rw	integer8	0
6061h	—	Control mode display	ro	integer8	0
6063h	—	Motor position feedback	ro	integer32	0
6064h	—	User position feedback	ro	integer32	0
606Bh	—	User velocity demand vaule	ro	integer32	0
606Ch	—	User actual velocity feedback	ro	integer32	0
606Dh	—	Velocity threshold	rw	unsigned16	0
606Eh	—	Velocity reaching time	rw	unsigned16	0
607Ch	—	Home offeset	rw	integer32	0
607Dh	01h	Software position limit: min position limit	rw	integer32	-2147483648
	02h	Software position limit: max position limit	rw	integer32	2147483647
607Eh	—	Reference polarity	rw	unsigned8	0

6080h	—	Max. motor speed	rw	unsigned32	10000
6083h	—	Profile acceleration	rw	unsigned32	1000
6084h	—	Profile deceleration	rw	unsigned32	1000
60B1h	—	Speed offset	rw	unsigned32	0
60B2h	—	Target velocity	Rw	unsigned32	0
60FFh	—	Target velocity	rw	integer32	0

5.12.4 Simple tutorial for cyclic synchronous velocity mode

I. Set parameter in servo drive

Table 5-65 Servo drive parameter for cyclic synchronous velocity mode

Parameter	Set value	Description
Pn002.2	1	Take absolute encoder as incremental. No need to change the parameter in absolute system.
Pn00B.2	1	Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter.

II. The host controller connects to servo drive and set the communication parameter(communication of synchronous cycle time, axis parameter, etc.)

III. Run the host controller

Table 5-66 Cyclic synchronous velocity mode startup and operation

Parameter	Set value	Description
60600008h	Control mode	9
60400010h Control word	Enable	Any number → 6 → 7 → 15 or MC_Power
	Alarm clear	Any number → 128(Enable on rising edge)
	Axis error reset	Set by host controller or by reference MC_Reset from PLC
60FF0020h	Demand velocity	Set by host controller or by reference MC_MoveVelocity from PLC
	Axis decelerate to stop	Set by host controller or by reference MC_Stop from PLC
	Cyclic synchronous time	Set by host controller (DC-SYn-chro)

5.12.5 Velocity reference filter

The velocity reference filter is a primary delay filter that is applied to the V-REF (Speed Command Input) signal to smooth the velocity reference.

Note: It is normally not necessary to change this parameter. If the setting is too high, the response to the speed reference may be slowed down.

Table 5-67 Velocity reference filter time constant parameter setting table

Pn307	Velocity reference filter time constant		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-65535	0.01ms	0		

E • Basic Function of Servo

5.13 Cyclic synchronous torque mode, CST

In Cyclic Synchronous Torque Mode, the host controller is to plan the torque ramp rate to reach the target torque and target torque in each synchronous cycle. Servo drive follows the target torque. To enable CST mode, set object 6060H to 10. It is available in EtherCAT. The control block diagram and input/output are shown in the following two figures.

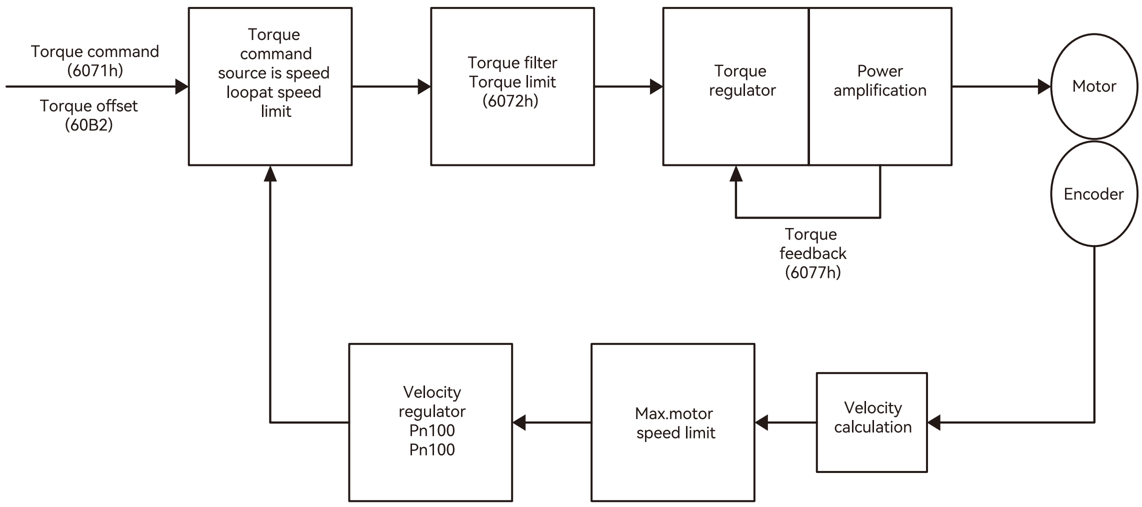


Figure 5-57 Cyclic synchronous torque mode input and output

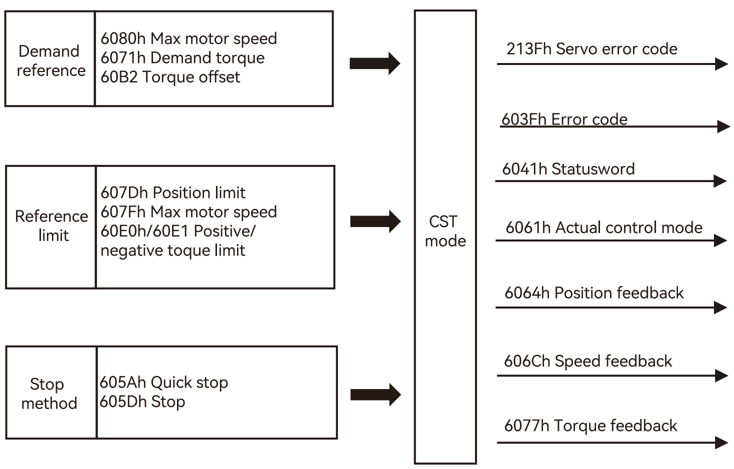


Figure 5-58 Cyclic synchronous torque mode input and output

5.13.1 Control word in cyclic synchronous torque mode (60400010h)

The meaning of each bit of control word(6040h) in cyclic synchronous torque mode is shown as the table below.

Table 5-68 Description of control word in cyclic synchronous torque mode

Bit	Name	Description
0	Switch on	Must be set to 1 when enable the servo
1	Enable voltage	Must be set to 1 when enable the servo
2	Quick stop	Must be set to 1 when enable the servo, if set to 0 then quick stop
3	Operation enable	Must be set to 1 when enable the servo
4 ~ 6	CSV mode reserved	-

7	Fault reset	When 0 → 1 executes alarm reset for once. If multiple resets are required, multiple changes from 0 → 1 are required. When it is set to 1, other control reference is disabled.
8	Halt	0: disabled, 1: enabled. When enabled the operation is halted.
9	CSV mode reserved	-
10	Reserved	-
11~15	Customized	-

5.13.2 Status word in cyclic synchronous torque mode (60410010h)

The meaning of each bit of status word in cyclic synchronous torque mode is shown as the table below. The item in dark background indicates the dedicated control reference in cyclic synchronous torque mode.

Table 5-69 Description of status word in cyclic synchronous torque mode

Bit	Name	Description
0	Ready to switch on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
1	Switched on	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
2	Operation enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled.
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled.
7	Warning	0: No warning, 1: Warning
8	Customized	-
9	Remote	0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled.
10	Reserved	-
11	Internal software limit active	0: Software limit position is not reached. 1: Software limit position is reached
12	Whether to follow target torque	0: Target torque is not followed, 1: Target torque has been followed.
13	CST mode reserved	-
14 ~ 15	Customized	-

5.13.3 Related dictionary objects in cyclic synchronous torque mode

Table 5-70 Related dictionary objects in cyclic synchronous torque mode

Index	Subindex	Signal	Access	Data type	Default value
603Fh	—	Error code	ro	unsigned16	0
6040h	—	Control word	rw	unsigned16	0
6041h	—	Status word	ro	unsigned16	0
6060h	—	Control mode	rw	integer8	0
6061h	—	Control mode display	ro	integer8	0
606Ch	—	User actual velocity feedback	ro	integer32	0
6071h	—	Target torque	rw	integer16	0
6074h	—	User demand torque	ro	integer16	0
6077h	—	Actual torque feedback	ro	integer16	0

607Dh	01h	Software position limit: min position limit	rw	integer32	-2147483648
	02h	Software position limit: max position limit	rw	integer32	2147483647
607Eh	—	Reference polarity	rw	unsigned8	0
607Fh	—	Max profile velocity	rw	unsigned32	2147483647
6087h	—	Torque ramp time	rw	unsigned32	0

5.13.4 Simple tutorial for cyclic synchronous position mode

I. Set parameter in servo drive

Table 5-71 Servo drive parameter for cyclic synchronous torque mode

Parameter	Set value	Description
Pn002.2	1	Take absolute encoder as incremental. No need to change the parameter in absolute system.
Pn00B.2	1	Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter.

II. The host controller connects to servo drive and set the communication parameter(communication of synchronous cycle time, axis parameter, etc.)

III. Run the host controller

Table 5-72 Cyclic Synchronous Torque Mode Startup and Operation

Parameter	Set value	Description
60600008h	Control mode	10(In hexadecimal is A)
60710010h 607F0020h	Demand torque/velocity	Set by reference MC_TorqueControl from PLC
60400010h Control word	Enable	Any number → 6 → 7 → 15/MC_Power
	Alarm clear	Any number → 128(Enable on rising edge)
	Axis error reset	Set by host controller, or by reference MC_Reset from PLC
	Cyclic synchronous time	Set by host controller(DC-SYn-chro)
607F0020h	Max profile velocity	-2147483648~2147483647

5.13.5 Torque reference filter

A function to smooth the torque reference by applying a primary delay filter to the torque reference input.

Note: It is normally not necessary to change this parameter. If the setting is too high, the response to the speed reference may be slowed down.

Table 5-73 Parameters for torque command filter

Pn415	T-REF filter time constant		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-65535	0.01ms	0		

5.13.6 Internal torque limit

The internal torque limit is a limiting method that limits the maximum output torque.

The setting unit is the motor rated torque percentage.

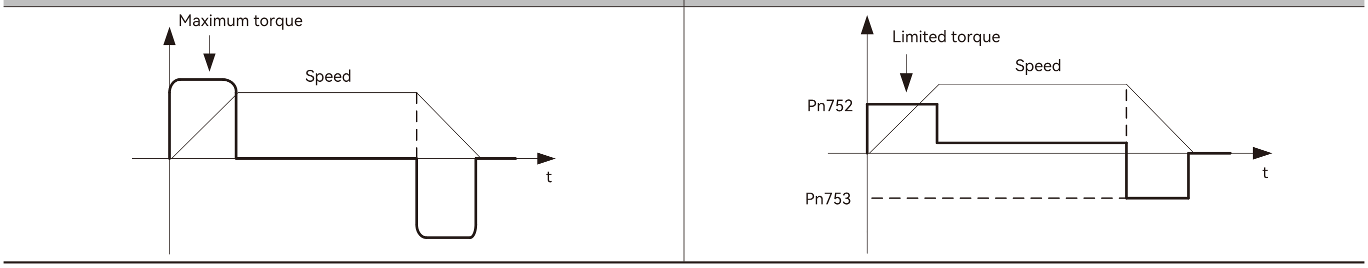
If the value is too low, it will cause insufficient torque during acceleration and deceleration.

Table 5-74 Internal torque limit parameter setting

Pn752	Forward torque limit		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-65535	0.1%	8000		
Pn753	Reverse torque limit		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-65535	0.1%	8000		

The torque waveform is as follows:

Without internal torque limits	With internal torque limits



5.14 Black box

5.14.1 Black box function configuration

The black box function can capture the data at the moment of a fault occurrence or under specified conditions and automatically save it. It can be read and uploaded through the background so that users can analyze and handle the causes of problems. The black box function of the 730W series is not enabled by default.

Table 5-75 Parameter setting table of Pn640 (Black box function configuration)

Pn640	Black box function configuration			When enabled	Classification
	Setting range	Unit	Default value	After restart	Setup
	0000 ~ FFFF	-	0011		

Note: When Bit0 = 0: The black box function is turned off.

When Bit0 = 1: The black box function is turned on, and any alarm or warning is used as the trigger.

When Bit0 = 3: The black box function is turned off, and the alarm set in PN641 is used as the trigger.

I. Black Box Alarm Data Latching Function

Table 5-76 Parameter setting table of Pn640=n. □□ X □ (Black box function configuration)

Parameter		Meaning	When enabled	Classification
Pn640.1 (Black box function configuration)	n. □□ 0 □ (Default value)	Latch the data of the ten times before the alarm	After restart	Setup
	n. □□ 1 □	Latch the data of five times before and after the alarm		
	n. □□ 2 □	Latch the data of the ten times after the alarm		

Note: After an alarm, it is necessary to connect to the host computer to read the black box data.

5.14.2 Black box latching alarm code setting

Table 5-77 Parameter setting table of Pn641 (Black box latching alarm code setting)

Pn641	Black box latching alarm code setting			When enabled	Classification
	Setting range	Unit	Default value	After restart	Setup
	0000 ~ FFFF	-	0000		

Example of the use of black box latching alarm code:

Set the corresponding alarm code. If it is A.C90, write C90 into PN641; if it is F10, write F10 into PN641.

5.15 Write parameters to EEPROM

Table 5-78 Parameter setting table of Pn790=n.X □□□ (Writing parameters to EEPROM switch)

Parameter		Meaning	When enabled	Classification
Pn790.3 (Writing parameters to EEPROM switch)	n. □□ 0 □ (Default value)	Write parameters to EEPROM (excluding Group 60)	After restart	Setup
	n. □□ 1 □	Do not write all parameters		
	n. □□ 2 □	Write all parameters to EEPROM		

When Pn790.3 = 0, the commonly used parameters except for the group with the address of 6000H can be written into the device (writing parameters of group 6000 is invalid).

When Pn790.3 = 1, writing all parameters into the device is invalid.

When Pn790.3 = 2, all parameters can be written into the device.

Chapter 6 Application Function

6.1 Absolute encoder

With a system that uses an absolute encoder, the host controller can monitor the current position.

Therefore, it is not necessary to perform an origin return operation when the power supply to the system is turned ON.

To save the position data of the absolute encoder, a battery unit is required. Install the battery on the encoder cable with the battery unit. When not using an encoder cable with a battery unit, install a battery in the host controller

Prohibition: Do not install batteries on both sides of the host controller and the battery unit (If installed on both sides at the same time, a short circuit will be formed between the batteries, which is very dangerous).

When using an absolute encoder, set Pn002.2=0 (Default value).

Table 6-1 Absolute encoder parameter setting

Parameter		Meaning	When enabled	Classification
PN002	n. □ 0 □□	Use the absolute encoder normally	After restart	Setup
	n. □ 1 □□ (Default value)	Use the absolute encoder as an incremental encoder		
	n. □ 2 □□	Use the encoder as a single-turn absolute encoder (rotary)		

6.1.1 Battery replacement

If the battery voltage drops to approximately 3.0 V or less, an A.830 alarm (Encoder battery alarm) or an A.930 warning (Absolute encoder battery error) will be displayed. When the above alarm or warning appears, please follow the steps below to replace the battery.

Whether to display an A.830 alarm or a A.930 warning is determined by the setting of Pn008.

Table 6-2 Alarm display parameter setting

Parameter		Meaning	When enabled	Classification
PN002	n. □□□ 0 (Default value)	Output alarm (A.830) for low battery voltage	After restart	Setup
	n. □□□ 1	Output warning (A.930) for low battery voltage		

◆ When Pn008.0=0 is set

The ALM signal is output for up to five seconds when the control power supply is turned ON, and then the battery voltage is monitored for four seconds. No alarm will be displayed even if the battery voltage drops below the specified value after these four seconds.

◆ When Pn008.0=1 is set

The ALM signal is output for up to five seconds when the control power supply is turned ON, and then the battery voltage is monitored continuously.

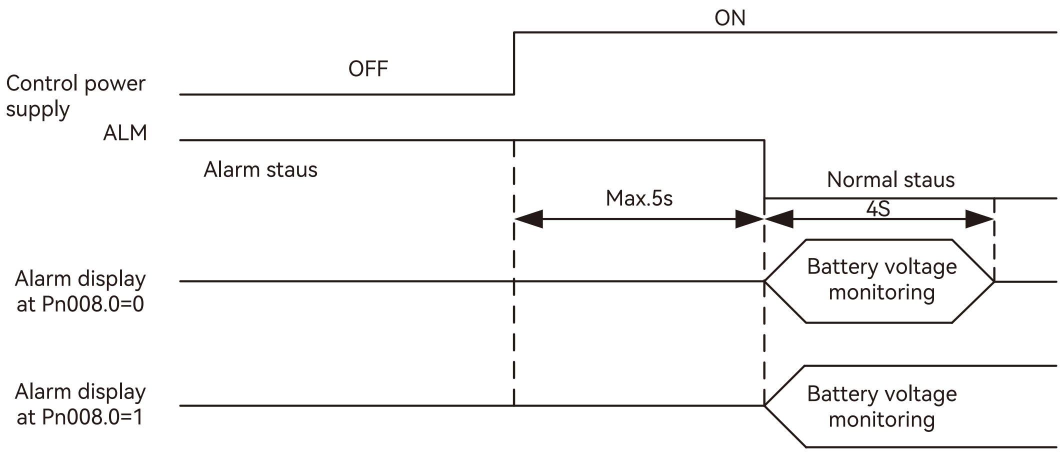
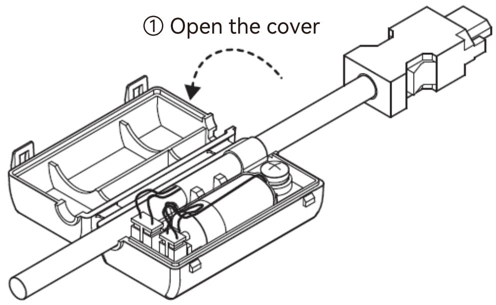


Figure 6-1 Alarm display timing chart

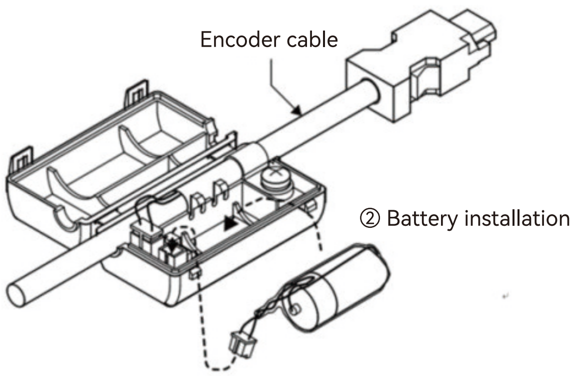
Battery replacement procedure when using an encoder cable with a battery unit:

(1) Only turn on the control power supply of the servo unit.

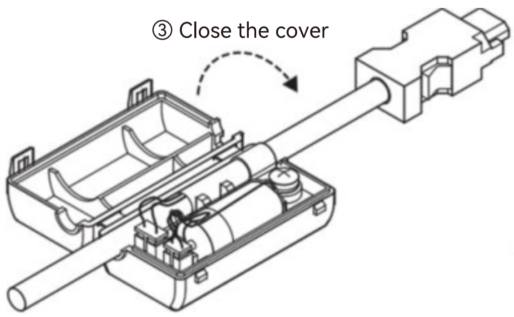
(2) Open the cover of the battery unit.



(3) Remove the old battery and mount a new battery.



(4) Close the cover of battery unit.



F • Application Function

(5) Turn OFF the power supply to the servo drive to clear the A.830 alarm(Encoder battery alarm).

(6) Turn on the power supply to servo unit again.

(7) Make sure that the alarm has been cleared and that the servo unit operates normally.

Note: If you remove the Battery or disconnect the encoder cable while the control power supply to the servo unit is OFF, the absolute encoder data will be lost.

6.1.2 Initialization of absolute encoder (when alarming)

CAUTION ⚠

- **After performing the absolute encoder setting, the rotation amount data will be set to a value within the range of -2 to +2 rotations. As the reference position of the mechanical system will change, determine the reference position of the host controller based on the new position after the setting.**
- **If the machine is started without adjusting the position in the host controller, unexpected operation may cause personal injury or damage to the machine.**

In the following cases, reset the absolute encoder:

・When starting the system for the first time.

・When "Encoder backup alarm (A.810)" occurs .

・When "Encoder checksum alarm (A.820)" occurs .

・When initializing the serial data of the absolute encoder rotation amount.

Perform basic initialization setting using Fn008.

- **Initial setting steps:**

① Press on the M panel key to select the Utility function Fn000, and the panel displays "Fn000" .

② Press the ∧ or ∨ key , the panel displays "Fn008".

③ Press the S key for about 1 second, the panel displays " PGCLI".

④ Press the ∧ key until the bread shows " PGCL5". (If you press wrong key operation in the process, the panel will display "oo oP" flashing for about 1 second, and then returns to the utility function mode. Then please restart the operation from the beginning)

⑤ Press M key to start resetting the absolute encoder. After the resetting is completed, the panel will display "dooF" flashing for about 1 second .

⑥ Return and the panel displays " PGCL5".

⑦ To make the setting active, please turn on the power again.

6.2 Position comparison output function

6.2.1 Function description

The position comparison function is to use the instantaneous position data to compare with the value stored in the data group in advance. When the comparison condition is satisfied, it will immediately output a DO signal with an adjustable pulse width for subsequent motion control.

Position comparison function: It can be selected to enable DO terminal output at high/low level. When enabled at high level, it is enabled when the corresponding DO terminal is connected to the common terminal, and it is disabled when it is disconnected from the common terminal; When enabled at low level, it is disabled when the corresponding DO terminal is connected to the common terminal, and enabled when it is disconnected. There are a total of 4 DO outputs on the 730W.

Table 6-3 Function description

Operating conditions of the position comparison output function	
Control mode	All control modes
Other	The elements besides the control parameters are properly set, and the motor is operating normally

6.2.2 Related objects

Table 6-4 Description table of related objects

Parameter	Name	Unit	Description
PN610	Position comparison output function	—	0: OFF (default setting); 1: Positive comparison; 2: Negative comparison; 3: Two-way comparison;
PN611	First set position	Pulse	-1073741824~1073741823
PN613	Second set position	Pulse	-1073741824~1073741823
PN615	Third set position	Pulse	-1073741824~1073741823
PN617	4th set position	Pulse	-1073741824~1073741823
PN619	Effective time of first position output signal	ms	0~65535
PN61A	Effective time of second position output signal	ms	0~65535
PN61B	Effective time of third position output signal	ms	0~65535
PN61C	Effective time of 4th position output signal	ms	0~65535
PN5B0.0~1	DO1 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)
PN5B. 10~1	DO2 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)
PN5B2.0~1	DO3 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)
PN5B3.0~1	DO4 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)
PN5B4.0~1	DO5 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)

PN5B5.0~1	DO6 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)
PN5B6.0~1	DO7 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)
PN5B7.0~1	DO8 output signal setting. signal assignment	—	0: Undefined 10: Position compare output 1 (POSCMP1) 11: Position compare output 2 (POSCMP2) 12: Position compare output 3 (POSCMP3) 13: Position compare output 4 (POSCMP4)

6.2.3 Function running

I. Function principle

Position comparison COMPARE is to use the instantaneous position data fed back by the servo to compare with the value stored in the target position array in advance. When the comparison condition is satisfied, it will immediately output a DO pulse signal (Number of DO and the pulse width can be configured) , used for the follow-up motion control. Since the comparison is done inside the FPGA, no software data communication delay, and accurate comparison can also be done for high-speed motion axes.

Position comparison output function: When the value 0 of the position comparison output function Pn610 changes to 1/2/3, the comparison starts. When Pn610 becomes 0, the comparison ends immediately, and the current comparison status is cleared.

Position comparison output width: When the position comparison condition is satisfied, output DO active level signal, the width of the active level signal can be set through Pn619/Pn61A/Pn61B/Pn61C. Setting range: 0 -65535 × 0.125 ms.

Target position comparison point: There are 4 target position comparison points in total, and the target position comparison value needs to be set to the Pn611/Pn613/Pn615/Pn617 target parameters in advance.

II. Functional operation

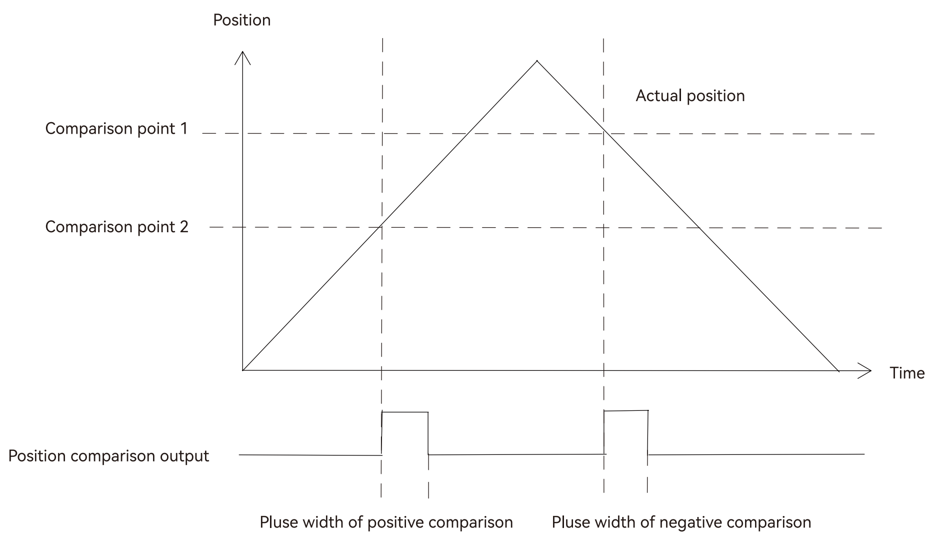


Figure 6-2 Operation chart

When Pn610 is set to 1- positive comparison output, when the axis passes the target position comparison point and the position relationship changes from low to high, DO outputs position comparison signal.

When Pn610 is set to 2- negative comparison output, when the axis passes the target position comparison point and the position relationship changes from low to high, DO outputs position comparison signal.

When Pn610 is set as 3- two-way comparison output, the signal output is independent of passing direction of the axis. When the target position comparison point is passed and the position relationship changes, DO outputs a position comparison signal.

6.3 Gravity compensation function

When the Servo motor is used with a vertical axis, gravity compensation prevents the moving part from falling due to the machine's own weight when the brake is released.

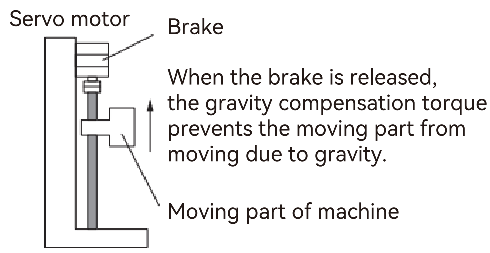


Figure 6-3 Operating diagram

A timing chart for when the moving part is raised then lowered is provided below.

For details of the brake operating time, please refer to the following chart.

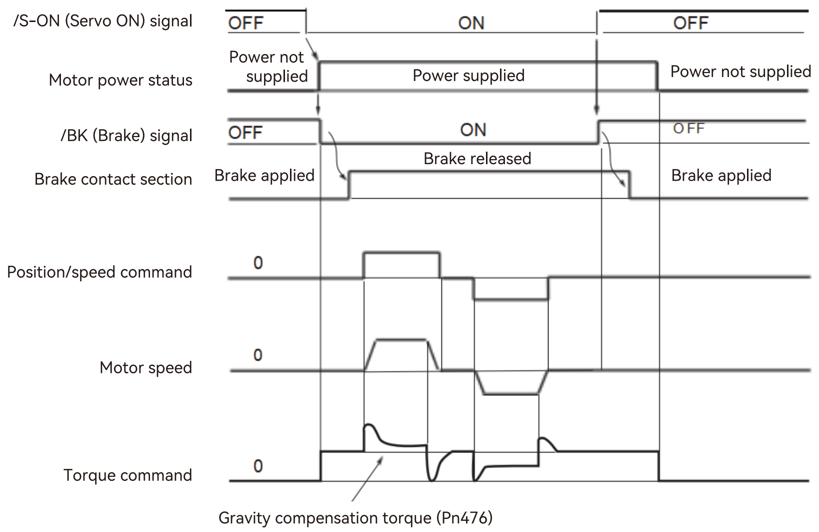


Figure 6-4 Brake application timing chart

6.3.1 Required parameters setting

To use the gravity compensation function, the following parameters are required.

Table 6-5 Parameter setting

Parameter	Function			When enabled
PN 609.bit5=0	Disable gravity compensation			After restart
PN 609.bit5=1	Enable gravity compensation			
PN 476	Setting range	Unit	Default value	Classification
	-1000 ~ 1000	0.1%	0	Immediately

6.3.2 Operating procedure for gravity compensation

The operating procedure of the gravity compensation function are as follows:

1. Set Pn609.1 = 2 (Enable gravity compensation).

2. To enable changes to the settings, turn the power of the servo unit OFF and ON again.

3. Use the Y7 host controller software HCServoWorks.Y7 to find the torque command value when the motor is stopped with the servo ON

4. Set the torque command value found in step 3 in Pn476 (Gravity Compensation Torque).

5. Turn servo ON/servo OFF several times, and fine-tune Pn476, so that the moving part of machine does not fall.

6.3.3 Operation steps of the automatic update gravity compensation function

The operation steps of the automatic update gravity compensation function are as follows:

Parameter	Function			When enabled
PN 609.bit5=0	Do not use the gravity compensation function			After restart
PN 609.bit5=1	Do not update automatically			
PN631.0=0	Do not update automatically			Immediately
PN631.0=1	Update automatically, and the data will be stored when the power is off.			
PN631.0=2	Update automatically, and the data will be stored when the power is off.			
PN 476	Setting range	Unit	Default value	Classification
	-1000 ~ 1000	0.1%	0	Immediately

1. Set PN609 = H0020;

When Bit5 = 0, the gravity compensation function is turned off.

When Bit5 = 1, the gravity compensation function is turned on.

Then set PN476 (Gravity compensation value: -1000 - 1000).

2. Set PN631.0 = 0: Do not automatically update PN476 (the default value is 0).

3. Set PN631.0 = 1: Automatically update. When power is on, automatically update the gravity compensation value of PN476, and when power is off, it will be re-initialized to the set value.

4. Set PN630.0 = 2: Automatically update. When power is on, automatically update the gravity compensation value of PN476, and store the value when power is off.

6.4 Forced DO function

6.4.1 Function description

There's two offline DO default options for EtherCAT forced DO state in non-OP state (including offline).

1. Offline holding state: The servo is switched to non-OP state and the DO is forced to maintain the state before disconnection.

2. Initialization state: When the servo is in non-OP state, disable the DO.

When the network is switched to OP, the forced DO is jointly determined by 60FE.01h/60FE.02h.

Select the forced DO function by bit. Select DO bit by bit as EtherCAT forced DO, which supprots part of DO is local function, and part of is EtherCAT forced output function. Y7S has 4 forced DO outputs, which can be monitored through the panel Un006, and DO status can also be monitored through the monitoring panel of the host computer.

6.4.2 Related objects

Table 6-6 Parameter table of related objects

Parameter No.	Signal	Setting range	Unit	Default value	When enabled	Classification	Reference
Pn080 (2080h)	DO1 output signal setting	0000H - 53FFH	—	1004H	After restart	Setup	—
Pn5B1	DO2 output signal setting	10 ~ 20000	0.1Hz	400	Immediately	Tuning	—
	Same as PN5B0 DO1 input signal setting signal assignment						
Pn5B2	DO3 output signal setting	15 ~ 51200	0.01ms	2000	Immediately	Tuning	—
	Same as PN5B0 DO1 input signal setting signal assignment						
Pn5B3	DO4 output signal setting	10 ~ 20000	0.1/s	400	Immediately	Tuning	—
	Same as PN5B0 DO1 input signal setting signal assignment						

Pn080 (2080h): n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 1, Bit 0:

Signal Assignment	
15	User-defined signal 1 (USER1)
16	User-defined signal 2 (USER2)
17	User-defined signal 3 (USER3)

Bit 2:

Polarity Control	
0	Signal not inverted (same polarity)
1	Signal inverted (opposite polarity)
2	Forced inactive
3	Forced active

Bit 3:

Not used	
0	Not used
1	A axes
2	B axes
3	C axes
4	D axes
5	All axes

Pn5B4	DO5 output signal setting	0 ~ 20000	1%	100	Immediately	Tuning	—
	Same as PN5B0 DO1 input signal setting signal assignment						
Pn5B5	DO6 output signal setting	10 ~ 20000	0.1Hz	400	Immediately	Tuning	—
	Same as PN5B0 DO1 input signal setting signal assignment						
Pn5B6	DO7 output signal setting	15 ~ 51200	0.01ms	2000	Immediately	Tuning	—
	Same as PN5B0 DO1 input signal setting signal assignment						
Pn5B7	DO8 output signal setting	10 ~ 20000	0.1/s	400	Immediately	Tuning	—
	Same as PN5B0 DO1 input signal setting signal assignment						

6.4.3 Instructions

1. Set the bit of Pn5B0~Pn5B7 to select the corresponding DO output.

2. Configure 60FE.01h/60FE.02h as RPDO and operate bit0~bit3(Set bit0 to 1 as USER1 output, Set bit 2 to 1 as USER2 output, set bit3 to 1 as USER3 output) to control DO output.

6.5 Software position limit function

6.5.1 Function description

In the traditional way, the limit position can only be given by an external signal, by connecting the external sensor signal to the CN1 interface of the servo drive.

Table 6-7 Comparison of advantages and disadvantages of hardware limit and software limit

Software limit		Software limit	
1	Can be only limited to linear motion, single-turn rotary motion	1	Can be used not only in linear motion but also in rotary mode
2	Requires external equipment to install mechanical limit switches	2	No hardware wiring is required to prevent the poor contact of the line from causing misoperation
3	Unable to judge mechanical slippage abnormality	3	Internal position comparison to prevent movement caused by mechanical slippage abnormal
4	When power off, unable to judge or alarm after machine moves out of the limit		

The software limit function refers to the comparison between the internal position feedback of the drive and the set limit value, and when the limit value is exceeded, a warning will be issued immediately and the shutdown operation will be executed. This function is available in both absolute position mode and incremental position mode.

6.5.2 Related objects

Table 6-8 Related objects parameters

	Signal	Unit	Value range	Default value	When enabled
PN781.bit0	Software limit switch	—	0-1	0	After restart
	0: Disabled; 1: Enabled				

Table 6-9 Software limit description

Object 607Dh: Software limit			
Objects description		Objects entry description	
Item	Value	Item	Value
Index	$607D_h$	Subindex	00_h

Signal	Number of software limit subindex	Access	Rw
Data structure	/	PDO mapping type	RxPDO
Data type	Uint8	Data range	0~512
Control mode	ALL	Default value	2

Objects description		Objects entry description	
Item	**Value**	**Item**	**Value**
Index	$607D_h$	Subindex:	01_h
Signal	Min. Software position limit	Access	Rw
Data structure	/	PDO mapping type	RxPDO
Data type	Sint32	Data range	-2147483648~2147483647
Control mode	ALL	Default value	-2147483648

Software limit function:

Bit0 of Pn781 is software limit switch;

0: Disabled;

1: Enabled;

Software limit function is enabled After restart;

Set the min. Value of software absolute position limit. When set to -2147483648, indicates no min software limit in negative direction = (607D-01h).

Item	Value	Item	Value
Index	$607D_h$	Subindex:	02h
Signal	Max. software position limit	Access	Rw
Data structure	/	PDO mapping type	RxPDO
Data type	Sint32	Data range	-2147483648~2147483647
Control mode	ALL	Default value	-2147483648

Software limit function:

Bit0 of Pn781 is software limit switch;

0: Disabled;

1: Enabled;

Software limit function is enabled After restart;

Set the max. Value of software absolute position limit. When set to 2147483648, indicates no max software limit in positive direction = (607D-02h).

6.5.3 Instructions

The software limit function refers to the comparison between the internal position feedback and the set limit value, when the limit value is exceeded, a warning will be issued immediately and shutdown will be executed. In the profile position mode, cyclic synchronous position mode, when the target position setting value is out of the software limit value, bit11 of the status word 06041 becomes TRUE and the drive runs with the limit value as the target position and prompts positive limit (..POT)/ negative limit(..NOT) warning, the drive stops according to the set overtravel stop mode. In other modes, when the position feedback 6064 is out of the software limit value, the drive will prompt a limit warning in the corresponding direction, and stops according to the set overtravel mode.

When 2781h=0, software limit function cannot be enabled.

When 2781h=1, software limit function is enabled After restart.

(607D-01h) min. software absolute position limit;

(607D-01h) max. software absolute position limit;

Note: 1. Ensure 607D-01 ≤ 607D-02, if 607D-01 > 607D-02 is set, .9B0 error (max. software position limit less than the min.) will be prompted on drive.

2. Ensure the value of 607C (home offset) is in the range of max. software limit and min. software limit, otherwise .9B1 error(home offset is out of the software limit) will be prompted on drive.

6.6 Modulus function

In absolute system, if Pn781.1=1, modulus mode is enabled. Meanwhile set the max. value of the modulus position of Pn78A, then the count value of 6064 can only be counted from 0 to the set value. It is enabled After restart.

Table 6-10 Modulus function description

	Signal	Unit	Value range	Default value	When enabled
PN781.bit1	Modulus switch	—	0~1	0	After power off
	0:Disabled; 1:Enabled				
PN78A	Modules function max. position limit	—	0-2147483648	0	After restart

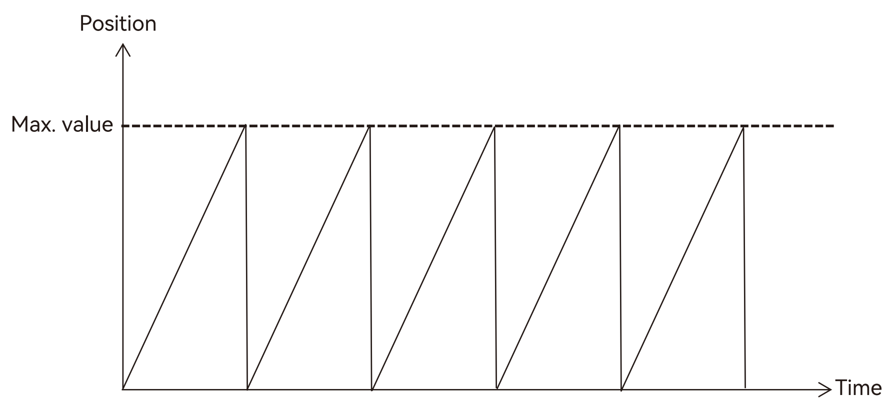


Figure 6-5 6064 waveform diagram after modulus enabled

Instructions:

1. When PN781.1 = 1, the modulo function is enabled. Consequently, the calculated value of 6064 can only be counted within the range from 0 to one less than the upper limit of the modulo value.

2. Set PN002.2 = 0 to utilize an absolute encoder.

3. The upper limit value of the modulo function for PN78A ranges from 0 to 4294967296. This setting will come into effect after power-off.

4. When PN790.3 = 2, all parameters should be written to the EEPROM. This measure is taken to prevent the position from changing after powering off and then on again. Such a change might occur due to the loss of the value of 607C when homing is carried out under the circumstance of multi-turn value overflow while the modulo function is in use.

6.7 Touch probe function

Touch probe function is for the servo drive records the position information and saves it to the designated register when the servo driver changes according to the externally specified DI signal or the motor Z signal. 730W servo drive supports 8 touch probes function(2 touch probes each axis). The falling edge of the Z signal is not currently supported.

The steps to use touch probe function are as follows:

1. Set the touch probe trigger DI signal: 730W servo drive designates A axis: DI3, DI4, B axis: DI8, DI9, C axis: DI3, DI4 and D axis: DI8, DI9 as the input DI of probe 0 and probe 1 for each axis, and the corresponding DI pins of probe 0 and probe 1 are D axis: 13, 14, C axis: 20, 21, B axis: 25, 26 and A axis: 31, 32 respectively;

2. Set the touch probe function(60B8h) code

The meanings of each bit of touch probe function (60B8h) and touch probe status word (60B9h) are shown in Table 6-17.

Table 6-11 Touch probe function code

Bit	Touch probe function (60B8h)	Touch probe stauts word (60B9h)
0	Enable touch probe 0 0: Disabled 1: Enabled	Enable touch probe 0 0: Disabled 1: Enabled
1	Touch probe 0 trigger mode 0: Trigger for once(60B8h need to set to 0) 1: Continuous triggering	Touch probe 0 rising edge latch 0: Rising edge latch of touch probe 0 not implemented 1: Rising edge latch of touch probe 0 is implemented
2	Touch probe 0 trigger signal selection 0: Triggered by DI3 1: Triggered by Z signal	Touch probe 1 falling edge latch 0: Falling edge latch not implemented 1: Falling edge latch is implemented
3	Reserved	Reserved
4	Touch probe 0 rising edge latch 0: Disabled 1: Enabled	Reserved
5	Touch probe 0 falling edge latch 0: Disbaled 1: Enabled	Reserved
6	Reserved	Touch probe 0 trigger signal selection 0: Triggered by DI3 1: Triggered by Z signal
7	Reserved	Touch probe 0 trigger DI level selection 0: DI3 is low level 1: DI4 is high level
8	Enable touch probe 1 0: Disabled 1: Enabled	Enable touch probe 1 0: Disabled 1: Enabled
9	Touch probe 1 trigger mode 0: Trigger for once(60B8h need to set to 0) 1: Continuous triggering	Touch probe 1 rising edge latch 0: Rising edge latch of touch probe 1 not implemented 1: Rising edge latch of touch probe 1 is implemented
10	Touch probe 1 trigger signal selection 0: Triggered by DI4 1: Triggered by Z signal	Touch probe 1 falling edge latch 0: Falling edge latch of touch probe 1 not implemented 1: Falling edge latch of touch probe 1 is implemented
11	Reserved	Reserved
12	Touch probe 1 rising edge latch 0: Disabled 1: Enabled	Reserved
13	Touch probe 1 falling edge latch 0: Disabled 1: Enabled	Reserved
14	Reserved	Touch probe 1 trigger signal selection 0: Triggered by DI5 1: Triggered by Z signal

15	Reserved	Touch probe 1 trigger DI level selection 0: DI4 is low level 1: DI4 is high level

For example, to use axis A probe 0 and probe 1 with both rising and falling edges, with DI (taking DI3 and DI4 as examples) single trigger, set 60B8h = 3131h (decimal representation: 12593). Then, on the rising edge of the DI3 and DI4 signals, the values of 60BAh and 60BCh will be updated; on the falling edge of the DI3 and DI4 signals, the values of 60BBh and 60BDh will be updated.

Note: If you wish to trigger again, you need to set 60B8h = 0, then set 60B8h = 3131h again. Commonly used object dictionaries for the probe function are shown in Table 6-18.

Table 6-12 Related touch probe function

Object dictionary	Meaning
60B8h	Touch probe function
60B9h	Touch probe status word
60BAh	Touch probe 0 rising edge position feedback
60BBh	Touch probe 0 falling edge position feedback
60BCh	Touch probe 1 rising edge position feedback
60BDh	Touch probe 1 falling edge position feedback

6.8 Safety funtion

◆ Safe torque off (STO)

To protect operator from injured by moving parts and lowering the risk of operating the machine, the servo unit is built in with safety function. Especially in the case that the shield must be opened during the maintenance, the safety function is able to prevent the machine from making dangerous movements.

6.8.1 Hard wire base block (HWBB) function

The hard wire base block function (hereinafter referred to as HWBB function) refers to the safety function of shutting off the motor current through hard wire circuit.

The drive signals to the Power Module that controls the motor current are controlled by the circuits that are independently connected to the two input signal channels to turn OFF the power module and shut OFF the motor current. Please refer to the figure in the following.

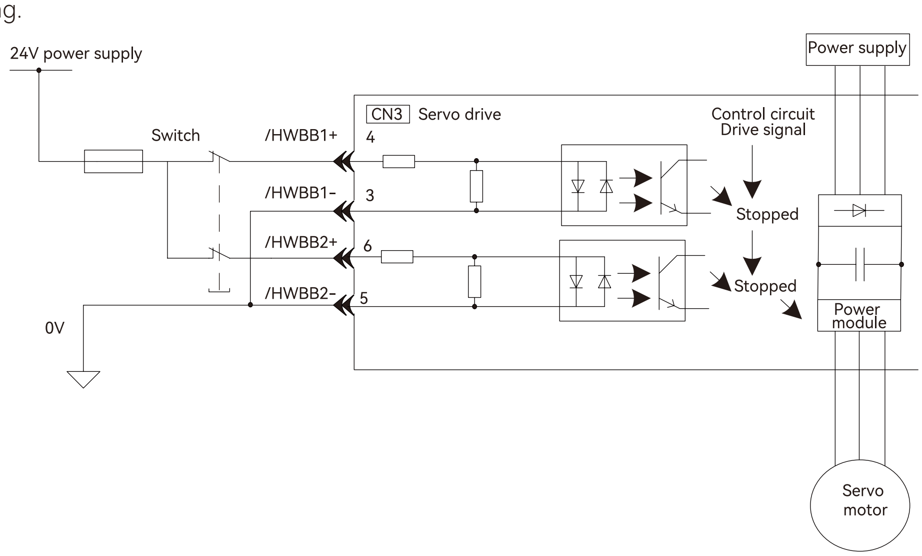


Figure 6-6 Hard wire base block function

Note: For safety function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

I. Risk assessment

Using the HWBB function, be sure to perform a risk assessment of the equipment to confirm that the safety level of the standards is satisfied.

Even if the HWBB function is effective, the following risks still exist, please be sure to consider the safety of the following factors in the risk assessment.

・The servo motor will move if an external force is applied to it (for example, gravity on a vertical axis). Implement measures to hold the servo motor, such as installing a separate mechanical brake.

・If a failure occurs such as a power module failure, the servo motor may move within an electric angle of 180. Check if there's a risk of danger.

The rotational angle or travel distance depends on the type of servo motor as follows.

Rotary servo motor: 1/6 rotation max (rotational angle calculated at the motor shaft).

Direct drive motor: 1/20 rotation max (rotational angle calculated at the motor shaft).

・The HWBB does not shut OFF the power to the servo unit or electrically isolate it. Implement measures to shut OFF the power supply to the servo unit before you perform maintenance on it.

II. Hard wire base block state (HWBB state)

The status of the servo unit when the hard wire base block function is running is as follows. When the /HWBB1 or /HWBB2 signal is OFF, the HWBB function of the servo unit will operate and the servo unit will enter the hard wire base block state (hereinafter referred to as the HWBB state).

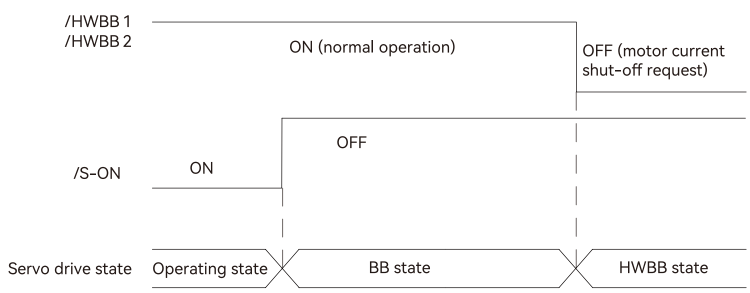


Figure 6-7 Hard wire base block state timing chart

III. Resetting the HWBB state

Normally, after the /S-ON signal is turned OFF and power is no longer supplied to the servo motor, the /HWBB1 and /HWBB2 signals will turn OFF and the servo unit will enter the HWBB state. If you turn ON the /HWBB1 and /HWBB2 signals in this state, the servo unit will enter a base block (BB) state and will be ready to acknowledge the /S-ON signal.

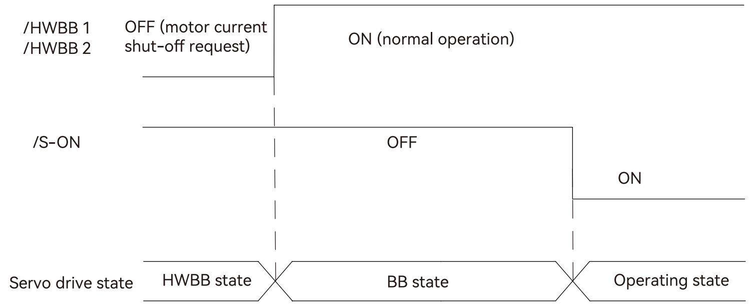


Figure 6-8 Hard wire base block state timing chart

If the /HWBB1 and /HWBB2 signals are OFF and the /S-ON signal is input, the HWBB state will be maintained even after the /HWBB1 and /HWBB2 signals are turned ON.

Turn OFF the /S-ON signal to place the servo unit in the BB state and then turn ON the /S-ON signal again.

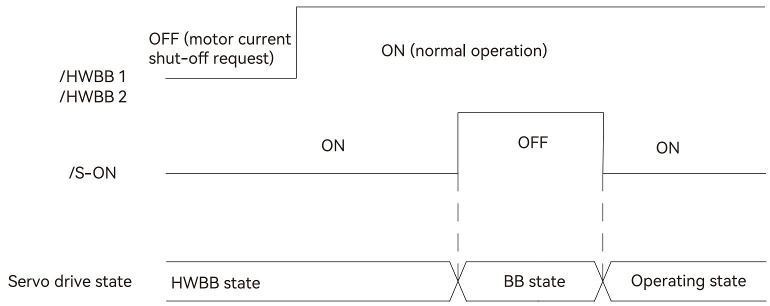


Figure 6-9 State reset timing chart

Note: 1. If the servo unit is placed in the BB state while the main circuit power supply is OFF, the HWBB state will be maintained until the /S-ON (Servo ON) signal is turned OFF.

2. If the /S-ON (Servo ON) signal is set to be always active(Pn50A.1), you cannot reset the HWBB state. Do not set this value if you are using the HWBB.

IV. Detecting errors in HWBB signal

If only the /HWBB1 or /HWBB2 signal is input, a safety function signal input timing error (A.Eb1) alarm will occur. This makes it possible to detect failures, such as disconnection of an HWBB signal.

Note: The A.Eb1 alarm (Safety function signal input timing error) is not a safety-related element. Keep this in mind when you design the system.

(五). Connection example and specifications of input signal (HWBB signal)

The input signal must be connected to the two input signal channels. The connection example and specifications of the input signal (HWBB signal) are as follows:

Note: For safety function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

Input signal (HWBB signal) connection example:

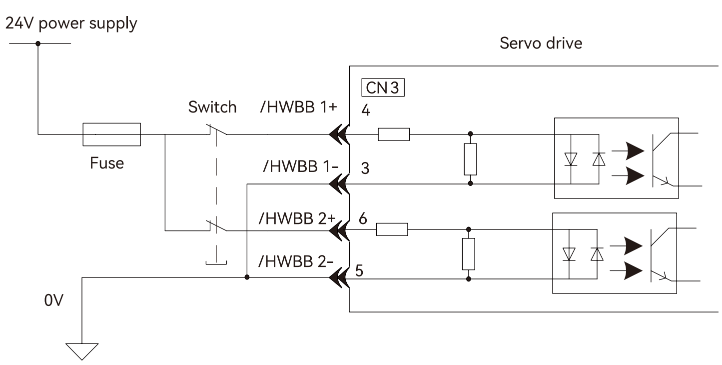


Figure 6-10 HWBB input signal connection example

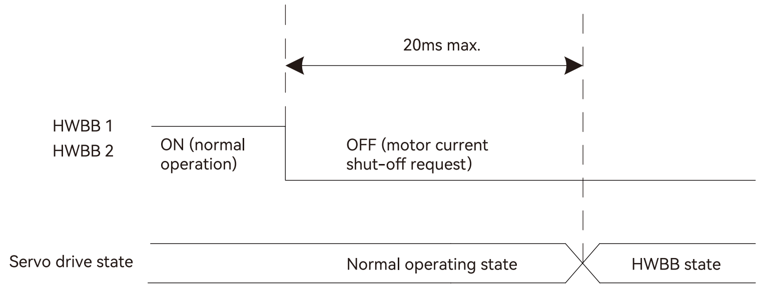
Table 6-13 Input signal (HWBB signal) specifications

Type	Name	Connector	Remarks	Meaning
Input	/HWBB1	CN3-4	ON (closed)	HWBB function is not active (normal)
		CN3-3	OFF (open)	HWBB function is active (requires to shut OFF the motor current)
	/HWBB2	CN3-6	ON (closed)	HWBB function is not active (normal)
		CN3-5	OFF (open)	HWBB function is active (requires to shut OFF the motor current)

Table 6-14 Input signal (HWBB signal) electrical characteristics

Item	Characteristic	Remarks
Internal resistance	4.7kΩ	-
Working voltage range	+11V ~ +25V	-
Maximum delay time	20ms	The interval between /HWBB1 and /HWBB2 OFF and HWBB function starts

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2), the power supply to the servo motor will be turned OFF within 20 ms.



Note: 1. The OFF status is not recognized if the OFF interval of the /HWBB1 or /HWBB2 signal is 0.5 ms or shorter.

2. You can check the status of the input signals by using monitor displays. For details, refer to "Safety input signal monitoring".

VI. When running through the utility function

The HWBB function is also available when running through Utility functions.

However, under the following Utility functions, the /HWBB1 and /HWBB2 signals are OFF. Even if the /HWBB1 and /HWBB2 signals are turned ON during the operation of the Utility functions, the operation will not work. Please exit utility function and enter again to restart

- Jogging(Fn002)
- Origin search (Fn003)
- Program jogging (Fn004)
- Advanced auto tuning (Fn201)
- EasyFFT (Fn206)
- Adjustment of motor current detection signal offset (Fn00E)

VII. Servo ready output (/S-RDY) signal

The /S-ON (Servo ON) signal will not be acknowledged in the HWBB state, so the servo ready output will turn OFF.

The servo ready output signal will turn ON if both the /HWBB1 and /HWBB2 signals are ON and the /S-ON signal is turned OFF.

An example is provided below for when the main circuit power supply is ON and the SEN signal turns ON when there is no servo alarm. (An absolute encoder is used in this example.)

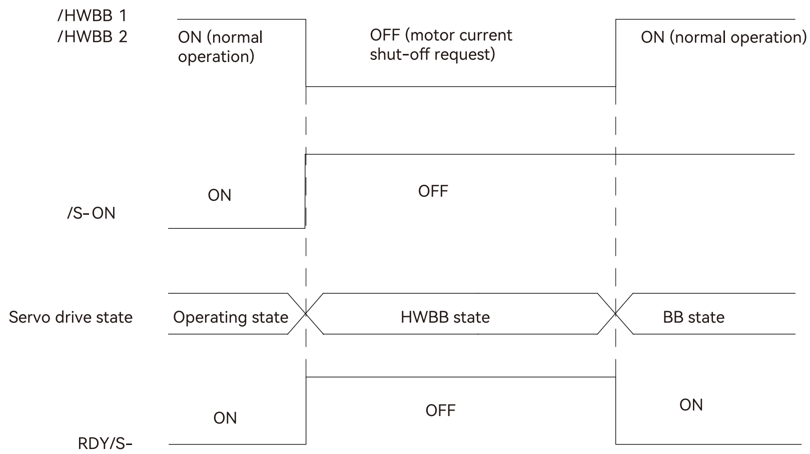


Figure 6-11 Servo ready output (/S-RDY) timing chart

(八). Brake signal (/BK)

If the HWBB operates when the /HWBB1 or /HWBB2 signal is OFF, the /BK (Brake) signal will turn OFF . At that time, the setting in Pn506 (Brake reference - servo OFF delay time) will be disabled. Therefore, the servo motor may be moved by external force until the actual brake becomes effective after the /BK signal turns OFF.

Note: Since the brake signal output is not a safety function, please ensure that no danger will occur even if the brake signal fails in the HWBB state when designing the system. In addition, please note that the brake of the servo motor is for fixing but not stopping the motor.

IX. Dynamic brake

When activate dynamic brake through Selection of Stopping Method at Servo OFF (Pn001.0), the dynamic brake will stop the servo motor after the /HWBB1 or /HWBB2 signal is OFF and the HWBB function is operating.

Note: 1. The dynamic brake is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the servo motor coasts to a stop in the HWBB state. Normally, we recommend that you use a sequence that returns to the HWBB state after stopping for a reference.

2. If the application frequently uses the HWBB, stopping with the dynamic brake may result in the deterioration of elements in the servo unit. To prevent internal elements from deteriorating, use a sequence in which the HWBB state is returned to after the servo motor has come to a stop.

X. Servo alarm output signal (ALM)

The servo alarm output signal (ALM) cannot be output in the HWBB state.

6.8.2 Validating safety functions

When you commission the system or perform maintenance or servo unit replacement, you must always perform the following validation test on the HWBB function after completing the wiring

When the /HWBB1 and /HWBB2 signals turn OFF, confirm that the panel operator displays "9b8" and that the servo motor does not operate.

Monitor the ON/OFF status of the /HWBB1 and /HWBB2 signals via Un015 .

If the ON/OFF status of the signals do not coincide with the display, the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the servo unit. Find the cause and correct the problem.

Confirm that the EDM1 signal is OFF while in normal operation by using the feedback circuit input display of the connected device.

6.8.3 Safety precautions when using the security function

・To confirm that the HWBB function satisfies the safety requirements of the system, you must conduct a risk assessment of the system. Incorrect use of safety function may cause injury.

・The servo motor will move if there is an external force (e.g., gravity on a vertical axis) even when the HWBB function is operating. Use a separate means, such as a mechanical brake, that satisfies the safety requirements.Incorrect use of the safety function may cause injury.

・While the HWBB function is operating, the servo motor may move within an electric angle of 180° or less as a result of a servo drive failure. Use the HWBB function for an application only after confirming that movement of the servo motor will not result in a hazardous condition.Incorrect use of the safety function may cause injury.

・Dynamic brake・The dynamic brake and the brake signal are not safety-related elements. You must design the system so that servo drive failures will not cause a hazardous condition while the HWBB function is operating.Incorrect use of the safety function may cause injury.

・Connect devices that satisfy the safety standards for the signals for safety functions.Incorrect use of the safety function may cause injury.

When using the HWBB function as an emergency stop function, please use an electrical mechanical part separately to cut of・f the power to the motor. Incorrect use of the safety function may cause injury.

・The HWBB function does not shut OFF the power to the servo drive or electrically isolate it. Implement measures to shut OFF the power supply to the servo drive before you perform maintenance on it.There is a risk of electric shock.

6.9 Soft start

The soft start function takes a stepwise speed command input and applies the specified acceleration/deceleration rates to convert it to a trapezoidal speed reference. Acceleration time and deceleration time can be set.

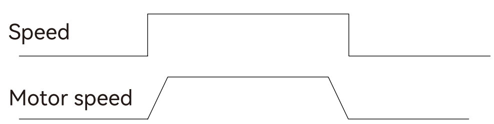


Figure 6-12 Soft start speed command and servo motor rate

Table 6-15 Soft start parameter setting table

PN305	Soft start acceleration time		Speed	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-65535	1ms	0		
PN306	Soft start acceleration time		Speed	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-65535	1ms	0		

Pn305: The time required for the servo motor to accelerate from a stopped state to the maximum motor speed.

Pn306: The time required for the servo motor to decelerate from the maximum motor speed to a stopped state.

The actual acceleration and deceleration time is calculated by the following formula.

Actual acceleration time = Target speed / 1000 x Soft start(Acceleration speed Pn305)

Actual deceleration time = Target speed / 1000 x Soft start(Acceleration speed Pn306)

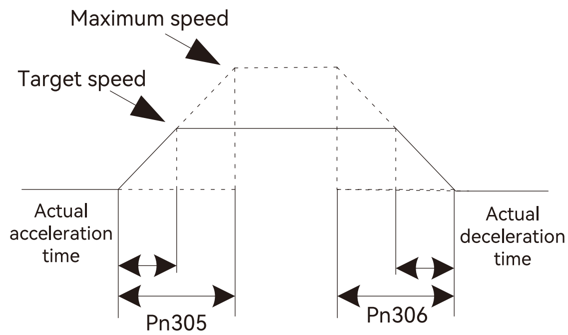


Figure 6-13 Pn305 and Pn306 command acceleration/deceleration time

6.10 Smooth function

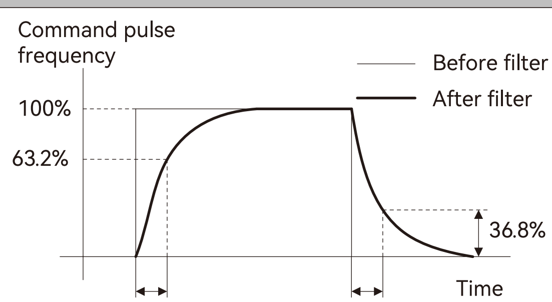
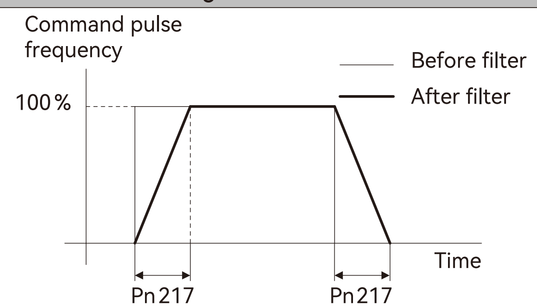
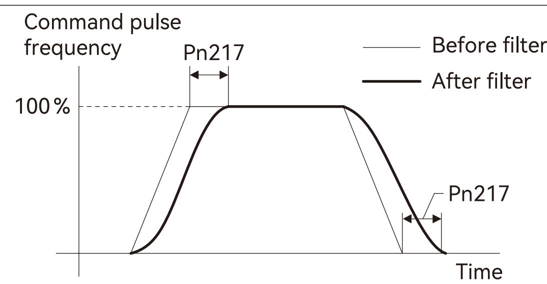
Apply a filter to the pulse input command to make command smoother.

Pn216	Position reference acceleration/deceleration time constant		Speed	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-65535	0.1ms	0		

Pn217	Position command moving average time		Speed	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-10000	0.1ms	0		

Pn216 and Pn217 functions are as follows:

Table 6-16 Timing difference between Pn216 and Pn217

Acceleration and deceleration filter	Average movement filter
	
	

6.11 Alarm delay disabling function

After the servo alarms, the delay disabling switch can be turned on by setting pn609.bit7 to 1. Then, the time can be set via PN60D to delay the disabling.

Table 6-17 Parameters table of alarm delay disabling function

Parameter		Meaning	When enabled	Classification
PN609.bit7 (Alarm delay disabling switch)	0 (Default value)	Turn off	After restart	Setup
	1	Turn on		

PN60D	Alarm delay disabling count			When enabled	Classification
	Setting range	Unit	Default value	After restart	Setup
	0-200	2ms	0		

Steps:

1. Set PN609 = H0080.

When Bit7 = 0, the delay disabling function is turned off.

When Bit7 = 1, the delay disabling function is turned on.

2. Set the disabling delay time in PN60D: The value ranges from 0 to 200, with the unit being 2 ms. Set it according to the actual situation.

Chapter 7 Tuning

7.1 About tuning

Tuning is used to optimize the response of the servo system through multiple parameters (speed loop gain, position loop-gain, filter, friction compensation, moment of inertia ratio, etc.). Therefore, when setting the servo gain, you have to consider the balance between the setting values of various parameters.

The default setting of the servo gain is stable. According to the status of the user's machine, the following auxiliary functions can be used to adjust the servo gain to further improve response. Advanced auto-tuning function is the latest gain control algorithm of 730W series servo dirve. After using this function, the above-mentioned parameters will be automatically adjusted.

Therefore, it is usually not necessary to adjust separately.

7.1.1 Basic tuning method

The table below provides a description of the auxiliary functions related to the adjustment. Please select according to the status and operating conditions of the machine you are using.

Table 7-1 Auxiliary functions

Auxiliary functions	Overview	Available control mode	Operating tool	
			Panel operator	HCServoWorks
Tuning-less (Fn200)	The setting of this function is invalid by default. If need to use this function, please set Pn170.0=1. Stable response can be obtained regardless of the type of machinery and load fluctuations.	Speed control Position control	√	√
Advanced auto-tuning 1 (Internal command)	When the automatic gain tuning function 1 is on, the servo drive will perform the following automatic adjustments. (recommended to use this function) • Moment of inertia ratio • Gain (position loop gain, speed loop gain, etc.) • Filter (torque command filter, notch filter) • Friction compensation • Adjust Anti-resonance Control • vibration suppression	Speed control Position control	x	√
Advanced auto-tuning 2 (Host controller command)	When the automatic gain tuning function 2 is on, the position command is input from the upper device, and the following automatic adjustments are performed. • Gain (position loop gain, speed loop gain, etc.) • Filter (torque command filter, notch filter) • Friction compensation • Adjust Anti-resonance Control • vibration suppression	Position control	x	√
One-parameter tuning	Input the position command or speed command from the host device, and perform the following adjustments. • Gain (position loop gain, speed loop gain, etc.) • Filter (torque command filter, notch filter) • Friction compensation • Adjust Anti-resonance Control	Speed control Position control	△	√

Adjust anti-resonance control function	To suppress vibration of 100~1000Hz	Speed control Position control	x	√
Vibration suppression function	To suppress aftershock generated during positioning	Position control	x	√

√ : Operable △ : Operable, but some functions are limited × : Not operable

7.1.2 Safety precautions at tuning

When making adjustments, be sure to observe the following precautions.

- Do not touch the rotating part of the motor while the servo is ON and the servo motor is running.
- When the servo motor is running, please make sure it can be stopped in an emergency at any time.
- Make adjustments after confirming that the test run is completed normally.
- To ensure safety, install a stop device on the machine side.

When making adjustments, please set the protection functions shown in the following items (1) to (5) under appropriate conditions.

(1) Overtravel setting

Please set the overtravel. For details, refer to " Section 5.4.3 Overtravel setting ".

(2) Torque limit setting

The torque limit function is a function that calculates the torque required for machine operation and limits the output torque so that it does not exceed the setting range. Shock can be reduced in the event of mechanical failure such as interference or collision. If the torque is lower than the value required for operation, overshoot or vibration may occur.

(3) Set the alarm value of excessive position deviation

The excessive position deviation alarm is an effective protection function when the servo drvie is used for position control.

When the servo motor action does not match the command, by setting an appropriate alarm value for excessive position deviation, the error can be detected and the servo motor will stop running.

The position deviation refers to the difference between the value of position command and the actual position.

Relationship between the position loop gain (Pn102) and the motor speed below.

① Please refer to "Section 5.6 Electronic gear ratio".

The calculation example when Pn102=400 Pn78C / Pn78E = 1 / 1

Pn520=600 / 60 × 1048576 / (400 ⁄10) × 1 / 1 × 2=2621440×2

=5242880(Pn520 Default value) × (1.2 ~ 2)

② When confirming the setting value of Pn102, please set the parameter display to "Display all parameters" (Pn00B.0 = 1).

Position deviation "Command unit"= Max. Motor speed[rpm] / 60 × Encoder resolution*1 / ((Pn102 [0.1 / s]) / 10 * 2) × Pn78C / Pn78E

Alarm value for excessive position deviation (Pn 520) [setting unit: 1 command unit]

Pn520 > Max. Motor speed[rpm] / 60 × Encoder resolution*1 / (Pn102 [0.1 / s] / 10 * 2) × Pn78C / Pn78E × (1.2~2)

" ×(1.2 ~ 2)" in the double underlined part is the surplus coefficient to avoid frequent occurrence of excessive position deviation alarm (A.d00).

As long as make the setting as above, the excessive position deviation alarm will not occur during normal operation.

When a position deviation occurs because the motor action does not match the command, an abnormal situation will be detected and the motor will stop running.

When the acceleration and deceleration of the position command exceeds the tracking capability of the servo motor, the position deviation cannot satisfy the above relational expression. Please reduce the acceleration and deceleration of the position command to the value that the motor can track, or increase the alarm value of excessive position deviation.

Table 7-2 Parameters for setting the alarm value of excessive position deviation

Pn520	Position deviation overflow alarm level		Position	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	1 ~ 1073741823	1 command unit	219895614		

Table 7-3 Alarm No.

Alarm number	Name	Content
A.d00	Position deviation overflow	The alarm displayed when the position deviation exceeds the position deviation overflow alarm level (Pn520).

(4) Set the vibration detection function

Set an appropriate value for the vibration detection function. For details, refer to " Section 8.14 Initialize vibration detection level (Fn01B)".

(5) Set the position deviation excessive alarm value when the servo is ON

If the position deviation is accumulating and turnon the servo, the servo motor will return to the original position in order to make the position deviation "0", which will cause danger. In order to avoid this kind of situation, the alarm value of excessive position deviation can be set when the servo is ON.

The relevant parameters and alarms are shown below.

Table 7-4 Set the parameters of excessive position deviation when the servo is ON

Pn526	Position deviation overflow alarm level at servo ON		Position	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	1 ~ 1073741823	1 command unit	5242880 0		
Pn528	Position deviation overflow alarm level at servo ON		Position	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	10 ~ 100	1%	100		
Pn529	Speed limit level at servo ON		Position	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0 ~ 10000	rpm	10000		

Table 7-5 Alarm No.

Alarm number	Name	Content
A.d01	Position deviation overflow alarm at servo ON	This is an alarm displayed when trying to turn on the servo while the position deviation is greater than the setting value of Pn526 during servo OFF.

A.d02	Position deviation overflow alarm for speed limit at servo ON	If the servo is ON while the position deviation is accumulating, the speed will be limited by the speed limit level at servo ON (Pn529) at servo ON. Input the command pulse in this state, and the alarm will be displayed when the setting value of position deviation overflow alarm level (Pn520) is exceeded.

7.2 Tuning-less function

Tuning-less function is set to "Invalid" at the default setting. If you use the Tuning-less function, please set Pn170.0=1. When resonance sound or vibration occurs, please change the rigidity value (Pn170.2) and load value (Pn170.3) through " Section 7.2.2 Operation steps of tuning-less level setting (Fn200)".

Note: 1. The tuning-less function is set to "invalid" at the factory. If you use the tuning-less function, please set Pn170.0=1. After the servo drive is installed on the machine, there will be a momentary sound when the servo is turned ON for the first time. This is the sound when the automatic notch filter is set, and it is not a malfunction. There will be no sound when the servo is turned ON next time. For details on the automatic notch filter, refer to "(3) About setting the automatic notch filter".

2. The servo motor may vibrate when used beyond the allowable moment of inertia of the load. At this time, please set Mode = 2 through Fn200, or lower the tuning value.

7.2.1 About the tuning-less function

The tuning-less function is to obtain a stable response through automatic adjustment regardless of the type of machine or load fluctuations.

(1) Set the tuning-less function to be valid/invalid

Tuning-less function can be set by the following parameters.

Table 7-6 Parameters of the tuning-less function

Parameter		Contents	When enabled	Classification
Pn170	n. □□□ 0 (Default value)	Disable the tuning-less function	After restart the power supply	Setup
	n. □□□ 1	Enable the tuning-less function		
	n. □□ 0 □ (Default value)	Used as speed control		
	n. □□ 1 □	For speed control, position control		

(2) Restrictions on usage

The tuning-less function is valid for position control and speed control, but invalid during torque control.

Meanwhile, when the tuning-less function is enabled, the control functions shown in the table below are partially restricted.

Table 7-7 Parameters of the tuning-less function

Function name	Executable/not executable	Executable conditions and remarks
Initialize vibration detection level (Fn01B)	√	—
Advanced auto tuning 1	△	Can be selected only at estimated moment of inertia. To be invalid at the tuning-less function executed , and becomes effective after tuning-less function ends.
Advanced auto tuning 2	x	—
One-parameter tuning	x	—

Anti-resonance control adjustment	x	—
Vibration suppression function	x	—
EasyFFT	√	—
Friction compensation	x	—
Gain switching	x	—
Estimated off-line moment of inertia (operated via HCServoWorks)	x	Operate after disable the tuning-less function (Pn170.0 = 0) .
Mechanical analysis (operated via HCServoWorks)	√	Operate after disable the tuning-less function (Pn170.0 = 0) .

√ : Operable △ : Operable, but some functions are limited × : Inoperable

(3) About setting the automatic notch filter

Generally, set it to "Automatic adjustment" (by default).

At "Automatic adjustment", vibration will be detected automatically when the tuning-less function is enabled, and the notch filter will be set.

Please set it to "Do not adjust automatically" only when you do not change the notch filter setting.

Table 7-8 Setting automatic notch filter parameters

Parameter		Contents	When enabled	Classification
Pn460	n. □ 0 □□	Automatic adjustment of the 2nd notch filter without auxiliary functions	Immediately	Setup
	n. □ 1 □□ (Default value)	Automatic adjustment of the 2nd notch filter by auxiliary function		

(4) About the tuning-less value

The tuning-less values: "Rigidity value" and "Load value". The adjustment value can be selected using the auxiliary function (Fn200) or the parameter setting (Pn170) .

Table 7-9 Rigidity values

Parameter		Meaning	When enabled	Classification
Pn170	n. □ 0 □□	Rigidity value 0 (Level0)	Immediately	Setup
	n. □ 1 □□	Rigid value 1 (Level1)		
	n. □ 2 □□	Rigid value 2 (Level2)		
	n. □ 3 □□	Rigid value 3 (Level3)		
	n. □ 4 □□ (Default value)	Rigid value 4 (Level4)		
	n. □ 5 □□	Rigid value 5 (Level5)		
	n. □ 6 □□	Rigid value 6 (Level6)		
	n. □ 7 □□	Rigid value 7 (Level7)		

Table 7-10 Rigidity values

Parameter		Contents	When enabled	Classification
Pn170	n. 0 □□□	Load value- lower (Mode0)	Immediately	Setup
	n. 1 □□□ (Default value)	Load value- medium (Mode1)		
	n. 2 □□□	Load value - higher (Mode2)		

7.2.2 Tuning-less value setting (Fn200)

The procedure for setting the tuning-less value is as follows.

The tuning-less value can be set by the operational panel or HCServoWorks.

(1) Confirmation before execution

Please confirm the following settings before performing tuning-less value. If the setting is not satisfied, " NO_OP " will be displayed during operation.

- Select tuning-less to be valid (Pn170.0 = 1).
- The write prohibition setting (Fn010) is disabled.

(2) Operations steps via the operation panel

① Press M key to switch to auxiliary function mode "Fn000".

② Press ∧ or ∨ key to "Fn200".

③ After long-pressing S for 1 sec., switch to the load value of tuning-less" d 1".

④ Press M key to switch to the rigidity setting screen of tuning-less" L 4".

⑤ Press ∧ or ∨ key to select the rigidity value. The higher the value, the higher the gain and the higher the response. (Default value:4)

- Vibration may occur when the rigidity value is too large. At this time, lower the rigidity value.
- When a high tone occurs, press S to automatically adjust the frequency of the notch filter to the vibration frequency.

⑥ Press M key, the status display will change to "donE" and flashes for about 1 sec., then displays"L0004".And the setting will be stored in the servo drive.

⑦ Press S for about 1 sec., then return to "Fn200".

Note: If overshoot occurs in the waveform, or when the load moment of inertia exceeds the allowable load (not subject to product warranty), press the key to change the load value to "2".

---

(3) Alarm and treatment method

When a resonance sound occurs or a large vibration occurs in position control, an auto-tuning alarm (A.521) may appear. In this case, perform the following steps.

- When resonance sound occurs

Decrease the setting value of Mode or Level through Fn200.

- When large vibration occurs during position control

Increase the setting value of Mode or Level through Fn200. It is also possible to increase the setting value of Pn170.3 or decrease the setting value of Pn170.2 through parameter setting.

(4) Parameters that make tuning-less function become invalid

When the tuning-less function is valid, the parameters Pn100, Pn101, Pn102, Pn103, Pn104, Pn105, Pn106, Pn160, Pn139, and Pn408 in the table below are invalid.

However, when the functions shown in the table below are executed, the above parameters related to gain may become valid.

For example, when Easy FFT is executed when the tuning-less function is valid, the setting values of parameters Pn100, Pn104, Pn101, Pn105, Pn102, Pn106, Pn103 and the manual gain switching are valid, and the setting value of Pn408.3, Pn160.0 and Pn139. 0 are invalid.

Table 7-11 Parameters that make tuning-less function become invalid

Parameters that make tuning-less function become invalid			Executed functions and valid parameters		
Items	Parameter	Parameter No.	Torque control	EasyFFT	Mechanical analysis (Vertical axis mode)
Gains	Speed loop gain 2nd speed loop gain	Pn100 Pn104	√	√	√
	Speed loop integral time constant Second speed loop integral time constant	Pn101 Pn105	x	√	√
	Position loop gain 2nd position loop gain	Pn102 Pn106	x	√	√
	Moment of inertia ratio	Pn103	√	√	√
Advanced control	Friction compensation function selection	Pn408.3	x	x	x
	Anti-resonance control selection	Pn160.0	x	x	x
Gain switching	Gain switching selection	Pn139.0	x	x	x

√ : The parameter setting value is valid   ×: The parameter setting value is invalid

7.2.3 Related parameters

The following 3 items are shown in the table below.

- Parameters associated with this function

The parameters used or referenced when executing this function.

- Is it possible to change the setting value of the parameter when executing this function?

"No": Parameters cannot be changed through HCServoWorks etc. when executing this function.

"Yes": Parameters can be changed through HCServoWorks etc. when executing this function.

- Whether there is automatic setting of parameters after executing this function

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-12 Parameters about tuning-less function

Parameter	Name	Possible to change the setting value	Automatic setting
Pn170	Tuning-less function	No	Yes
Pn401	1st stage 1st torque command filter time constant	No	Yes
Pn40C	2nd stage notch filter frequency	No	Yes
Pn40D	2nd stage notch filter Q value	No	Yes

7.3 Advanced auto-tuning 1 - by HCServoWorks internal position command

This section explains how to perform adjustments with advanced auto-tuning 1.

Note: 1. Advanced auto-tuning 1 controls the operation of the mechanism through the internal position command of the HCServoWorks software. Pay attention to the safety distance and mechanical collision when using it.

2. When using advanced auto tuning 1, please ensure that the tuning-less function Pn170.0=0.

3. Advanced auto-tuning 1 starts to adjust based on the currently set speed loop gain (Pn100). Therefore, if vibration occurs at the start of adjustment, correct adjustment will not be possible.

At this time, please reduce the speed loop gain (Pn100) until the vibration disappears

4. After performing advanced auto-tuning 1, if the advanced auto-tuning of "Estimated load moment of inertia" is performed again due to changes in the load state and transmission mechanism of the machine, please change the following parameters number, and set all the set values after the last adjustment to be invalid. If advanced auto-tuning 1 is performed without changing the parameters, it may cause mechanical vibration or damage.

① Pn00B.0 = 1 (Display all parameters)

② Pn140.0 = 0 (Do not use model tracking control)

③ Pn160.0 = 0 (Adjust anti-resonance Control is not used)

④ Pn408 = n.00 • 0 (Do not use friction compensation, 1st or 2nd notch)

5. The operation of Advanced auto-tuning 1 can be performed through HCServoWorks. This function cannot be operated through the operation panel.

(1) Execute through the HCServoWorks software on the host computer.

(2) Execute through the panel buttons (refer to 8.17 Advanced auto-tuning 1 for detailed operation methods).

(3) Execute via parameter startup, see the table below for parameter details (refer to 5.2.6 Numerical setting type operation for specific operation methods).

Table 7-13 Parameter startup tuning correspondence

<table>
<tr><th colspan="2">Parameter</th><th colspan="2">Function</th></tr>
<tr><td rowspan="11">Pn6B1
One-key tuning control (Fn201)</td><td>0</td><td>Stop</td><td rowspan="10">With offline inertia</td></tr>
<tr><td>1</td><td>Medium rigidity structure, interpolation mode</td></tr>
<tr><td>2</td><td>Medium rigidity structure, rapid positioning mode</td></tr>
<tr><td>3</td><td>Medium rigidity structure, standard mode</td></tr>
<tr><td>4</td><td>Low rigidity structure, interpolation mode</td></tr>
<tr><td>5</td><td>Low rigidity structure, rapid positioning mode</td></tr>
<tr><td>6</td><td>Low rigidity structure, standard mode</td></tr>
<tr><td>7</td><td>High rigidity structure, interpolation mode</td></tr>
<tr><td>8</td><td>High rigidity structure, rapid positioning mode</td></tr>
<tr><td>9</td><td>High rigidity structure, standard mode</td></tr>
<tr><td>11~19</td><td>The function settings are the same as those of 1~9</td><td>Without offline inertia</td></tr>
<tr><td colspan="2">Pn6B2
Tuning travelling distance</td><td colspan="2">Range: -32768~32767</td></tr>
<tr><td colspan="2">Pn6B3
Tuning initial gain level</td><td colspan="2">0: No initial value, subject to the speed loop gain (Pn100)
1~5: The larger the value, the greater the gain</td></tr>
<tr><td colspan="2">Pn6B4
Tuning initial estimated inertia</td><td colspan="2">0: No initial value, subject to the starting value of moment of inertia estimation (Pn324)
1~3: The larger the value, the higher the inertia level
(Only valid when inertia estimation is enabled)</td></tr>
<tr><td colspan="2">Pn6B5
Tuning initial positioning accuracy</td><td colspan="2">0: No initial value, subject to the positioning completion range (Pn522)
1~9: The larger the value, the lower the positioning accuracy</td></tr>
<tr><td colspan="2">Pn6B6
Percentage when saving the gain</td><td colspan="2">Range: 1~100</td></tr>
<tr><td rowspan="2">Pn6B7
Tuning configuration function</td><td>n. □□□ 0</td><td colspan="2">None</td></tr>
<tr><td>n. □□□ 1</td><td colspan="2">When the tuning starts, automatically adjust and force the initialization of relevant functions (model tracking, type A vibration suppression, notch filter, vibration suppression)</td></tr>
</table>

Table 7-14 Description of tuning mode

Mode	Content
Tuning mode 1 (standard)	Adjust gain, notch filter, A-mode vibration
Tuning mode 2 (positioning oriented)	Adjust the gain, model tracking, notch filter, anti-resonance, and vibration suppression
Tuning mode 3 (positioning oriented < emphasis on overshoot >)	Adjust gain, notch filter, anti-resonance, and vibration suppression

Table 7-15 Mechanism selection explanation

Mechanism selection	Mechanism type
Low rigidity structure	Conveyor belt structure
Medium rigidity structure	Ball screw, linear motor
High rigidity structure	Rigid body system

7.3.1 About auto-tuning 1

Advanced auto-tuning 1 refers to the function that the servo drive automatically adjusts according to the mechanical characteristics when performing automatic operation (forward and reverse reciprocating motion) within the setting range.

Advanced auto-tuning can be performed without connecting a host controller.

The operation specifications of automatic operation are as follows.

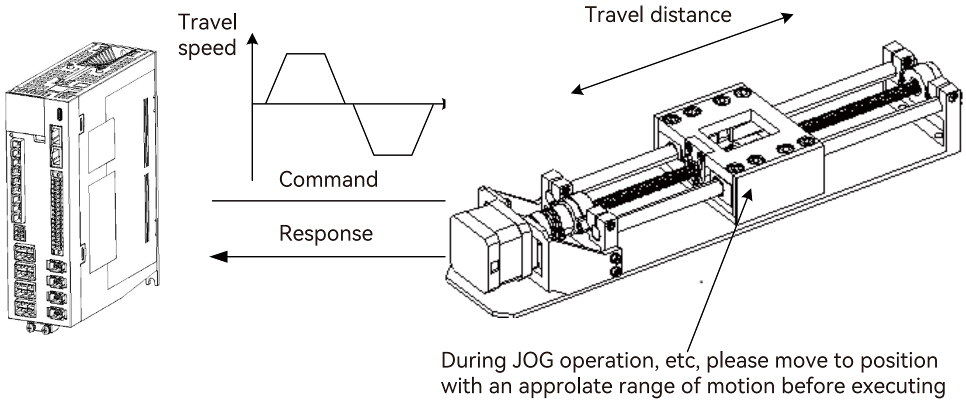


Figure 7-1 Automatic operation specification

Maximum speed: Motor rated speed × (2/3) .

- Acceleration torque: About 100% of the rated torque of the motor.
- Acceleration torque will change according to the setting of moment of inertia ratio (Pn103), mechanical friction, and external disturbance.
- Travelling distance: Can be set arbitrarily. The default setting is equivalent to 3 revolutions of the servo motor.
- Items of advanced auto-tuning 1 :
- Moment of inertia ratio.
- Gain adjustment (speed loop gain, position loop gain, etc.).
- Filter adjustment (torque command filter, notch filter).
- Friction compensation.
- Anti-resonance control adjustment.
- Vibration suppression (only when mode = 2 or 3).

Note: Advanced auto-tuning 1 performs adjustments in automatic operation mode, so vibration or overshooting may occur during operation. In order to ensure safety, please execute the advance auto tuning in the state of emergency stop at any time.

Confirmation items before execution

Before performing advanced auto tuning 1, be sure to confirm the following settings. When the following items are not set, the operation will display "NO_OP ":

- The main circuit power supply must be ON
- Servo must be OFF

- Forward-rotation prohibition (P-OT), reverse-rotation prohibition (N-OT) must not be in an overtravel state
- The clear signal must be L level (not cleared)
- Not for torque control
- The gain switching selection is manual gain switching (Pn139.0 = 0).
- The 1st gain is selected.
- No servo motor test function selection is invalid (Pn00C.0 = 0).
- No alarms or warnings occurred.
- Hardwired base block function (HWBB) is invalid
- Auto gain switching must be disabled
- Write prohibition should be disabled(Fn010)
- Set the tuning-less function to be invalid (Pn170.0 = 0)

< Supplement >

- When the advanved auto-tuning is performed under speed control, it will automatically switch to position control. And return to speed control after adjustment.

In the following cases, advanced auto tuning 1 cannot be performed normally. Please adjust with advanced auto tuning 2 or One-parameter tuning.

- When a mechanical system can only operate in one direction.
- The range of activity is narrow, and it is below 0.5 circles.

Advanced auto-tuning 2 → refer to "Section 7.4 Advanced auto-tuning 2".

One-parameter tuning → refer to " Section 7.5 One-parameter tuning".

Adjustment with advanced auto tuning 1 cannot be performed smoothly in the following cases. Please adjust with advanced auto tuning 2 or One-parameter tuning.

- When an appropriate range of motion cannot be obtained.
- When the moment of inertia fluctuates within the setting range.
- When the dynamic friction of the machine is large.
- When the rigidity of the machine is low and vibration occurs during the positioning operation.
- When using the position integration function.
- During P (proportional) control.

Note: When set to "Estimated moment of inertia ", "Error" will be displayed during the process of estimated the moment of inertia, or when switching to P control via the /P-CON signal.

- When using the mode switch.

Note: When set to "Estimated moment of inertia", the mode switch function becomes invalid during the process of estimating the moment of inertia, and becomes PI control. Mode switch function becomes valid again after the moment of inertia estimation is completed.

- When speed feedforward and torque feedforward are input.
- When the tuning initial positioning accuracy (Pn6B5) is narrow.

Advanced auto-tuning 2 → Refer to "Section 7.4 Advanced auto-tuning 2".

One-parameter tuning → Refer to " Section 7.5 One-parameter tuning".

Fine-tuning the overshoot without changing the positioning completion width (Pn522) , use the overshoot detection value (Pn561). Since the default setting of Pn561 is 100%, it is allowed to adjust up to the same overshoot as the positioning completion width. If changed to 0%, the adjustment can be performed without overshoot within the positioning completion width.

However, after changing this value, the positioning time may be extended.

Table 7-16 Overshoot detection value parameters

Pn561	Overshoot detection value		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-100	1%	100		

7.3.2 Precautions for advanced auto-tuning 1

When an abnormal operation occurs during the execution of advanced automatic tuning 1, the causes and countermeasures are as follows:

If the advanced automatic tuning 1 fails, deal with it by checking the causes and countermeasures corresponding to the alarm number.

Table 7-17 Tuning alarm number correspondence table

Alarm No.	Cause	Countermeasure
A.9C0 Advanced automatic tuning alarm 1	Operation status error	-
A.9C1 Advanced automatic tuning alarm 2	When the non-adjustment function is enabled, the moment of inertia estimation has not been executed.	Set "Estimated moment of inertia [Default]" in the HCServoWorks startup mode. Restart the tuning, or set "J. ON" in the operation panel startup mode.
		Restart the tuning, or set the non-adjustment function to invalid (Pn170.0 = 0).
A.9C2 Advanced automatic tuning alarm 3	The positioning completion signal [COIN] has not been detected for more than 10 seconds.	Increase the initial gain level of the advanced automatic tuning (Pn6B3) by one level, or increase the positioning accuracy of the advanced automatic tuning (Pn6B5) by one level.
A.9C3 Advanced automatic tuning alarm 4	The speed loop gain search has reached the lower limit.	Decrease the initial positioning accuracy of the automatic tuning (Pn6B5) by one level.
	Mechanical vibration has occurred.	The vibration can be suppressed through the type A vibration suppression adjustment function and the vibration suppression function.
A.9C4 Advanced automatic tuning alarm 5	The position loop or model loop gain search has reached the lower limit.	Increase the positioning accuracy of the advanced automatic tuning (Pn6B5) by one level.
	When the motor is stopped, the positioning completion signal (/COIN) is unstable and is turning ON/OFF.	Set "Positioning correspondence (focus on overshoot)" in the HCServoWorks startup mode. Restart the tuning, or set "L. 3" in the operation panel startup mode to restart the tuning.
	Mechanical vibration has occurred.	Suppress the vibration through the type A vibration suppression adjustment function and the vibration suppression function.
A.9C5 Advanced automatic tuning alarm 6	The action of the self-estimation of the moment of inertia has started, but the estimation process has not been executed.	Increase the initial gain level of the automatic tuning (Pn6B3) by one level.
		Increase the moving distance.

G • Tuning

A.9C6 Advanced automatic tuning alarm 7	The deviation of the estimation result of the self-estimation of the moment of inertia is too large, and the deviation still has not decreased after 10 times of retries.	The current mechanical inertia cannot be estimated. Manually set the moment of inertia ratio (Pn103) directly according to the mechanical specifications. Set "Do not estimate moment of inertia" in the HCServoWorks startup mode and restart the tuning, or set "J. OFF" in the operation panel startup mode and restart the tuning.
A.9C7 Advanced automatic tuning alarm 8	Low-frequency vibration has been detected during the self-estimation process of the moment of inertia.	Increase the initial inertia level of the advanced automatic tuning (Pn6B4) by one level.
A.9C8 Advanced automatic tuning alarm 9	The torque limit value has been reached.	Increase the limit value when the torque limit is set. Increase the initial inertia level of the advanced automatic tuning (Pn6B4) by one level.
A.9C9 Advanced automatic tuning alarm 10	During the self-estimation process of the moment of inertia, the external input of (/P-CON) has changed the speed loop control mode to P control.	Switch to PI control during the self-estimation of the moment of inertia.
A.9CA Advanced automatic tuning alarm 11	An alarm or warning occurred in the servo during the tuning process.	Eliminate the cause of the alarm or warning and then retry.
A.9CB Advanced automatic tuning alarm 12	The servo main power is not ready during the tuning process.	Connect the main circuit power supply and then retry.
A.9CC Advanced automatic tuning alarm 13	The servo is in an over-travel state during the tuning process.	Eliminate the cause of the over-travel and then retry.
A.9CD Advanced automatic tuning alarm 14	The servo is not enabled during the tuning process.	Do not perform the servo enable OFF operation during the tuning operation.
A.9CE Advanced automatic tuning alarm 15	The currently effective gain of the servo during the tuning process is not the first gain.	Set the automatic gain switching to invalid (Pn139.0 = 0) and the G-SEL to the OFF state.
A.9CF Advanced automatic tuning alarm 16	The servo is in the STO state during the tuning process.	Release the STO state and then retry.
A.9D0 Advanced automatic tuning alarm 17	The magnetic polarity detection has not been carried out before tuning.	Perform the "Magnetic pole detection" operation first and then retry.
A.9D1 Advanced automatic tuning alarm 18	The tuning process has exceeded the maximum time limit.	Confirm the mechanical connection situation and then retry.
A.9D2 Advanced automatic tuning alarm 19	The saving of the gain result failed after the tuning was completed.	Do not perform other parameter writing operations during the tuning process and then retry.
A.9D3 Advanced automatic tuning alarm 20	The downstream command from the host computer timed out during the tuning process.	Check whether the USB connection is good or replace the USB cable and then retry.

Note: If a tuning-related warning occurs, there is no need to manually clear it. Just restart the tuning.

7.4 Advanced auto-tuning 2 - via host controller position commands

This section describes the adjustment method for advanced auto-tuning 2. This function controls the mechanism through operation commands from the host device, hence it is also called advanced auto-tuning 2.

Note: 1. Advanced auto-tuning 2 is operated by the control mechanism of the host device's operation command (Pulse sequence command). Pay attention to the safety distance and mechanical collision when using.

2. When using advanced auto-tuning 2, please ensure that the tuning-less function Pn170.0=0 is turned off.

3. Advanced auto-tuning 2 starts to adjust based on the currently set speed loop gain (Pn100). Therefore, if vibration occurs at the start of adjustment, correct adjustment will not be possible.

At this time, please reduce the speed loop gain (Pn100) until the vibration disappears.

4. After performing advanced auto-tuning 2, if the "Estimated moment of inertia" is performed again due to changes in the load state and transmission mechanism of the machine, please change the following parameters and set all the set values to be invalid. If advanced auto-tuning 2 is performed without changing the parameters, it may cause mechanical vibration ordamage.

① Pn00B.0 = 1 (Display all parameters)

② Pn140.0 = 0 (Do not use model tracking control)

③ Pn160.0 = 0 (Do not use Adjust Anti-resonance Control)

④ Pn408 = n.00 • 0 (Do not use friction compensation, 1st or 2nd notch)

5. The operation of advanced auto-tuning 2 can be performed through HCServoWorks. This function cannot be operated through the operation panel.

(1) Execute through the HCServoWorks software on the host computer.

(2) Execute through the panel buttons (refer to 8.18 Advanced auto-tuning 2 for the specific operation method).

(3) Execute by starting with parameters. See the following table for detailed parameters (refer to 5.2.6 Numeric settings for the specific operation method).

Table 7-18 Parameter startup tuning correspondence

<table>
<tr><th colspan="2">Parameter</th><th colspan="2">Function</th></tr>
<tr><td rowspan="11">Pn6B0
One-key tuning control</td><td>0</td><td>Stop</td><td rowspan="10">With offline inertia</td></tr>
<tr><td>1</td><td>Medium rigidity structure, interpolation mode</td></tr>
<tr><td>2</td><td>Medium rigidity structure, rapid positioning mode</td></tr>
<tr><td>3</td><td>Medium rigidity structure, standard mode</td></tr>
<tr><td>4</td><td>Low rigidity structure, interpolation mode</td></tr>
<tr><td>5</td><td>Low rigidity structure, rapid positioning mode</td></tr>
<tr><td>6</td><td>Low rigidity structure, standard mode</td></tr>
<tr><td>7</td><td>High rigidity structure, interpolation mode</td></tr>
<tr><td>8</td><td>High rigidity structure, rapid positioning mode</td></tr>
<tr><td>9</td><td>High rigidity structure, standard mode</td></tr>
<tr><td>11~19</td><td>The function settings are the same as those of 1~9</td><td>Without offline inertia</td></tr>
<tr><td colspan="2">Pn6B3
Tuning initial gain level</td><td colspan="2">0: No initial value, subject to the speed loop gain (Pn100)
1~5: The larger the value, the greater the gain</td></tr>
<tr><td colspan="2">Pn6B4
Tuning initial estimated inertia</td><td colspan="2">0: No initial value, subject to the starting value of moment of inertia estimation (Pn324)
1~3: The larger the value, the higher the inertia level
(Only valid when inertia estimation is enabled)</td></tr>
<tr><td colspan="2">Pn6B5
Tuning initial positioning accuracy</td><td colspan="2">0: No initial value, subject to the positioning completion range (Pn522)
1~9: The larger the value, the lower the positioning accuracy</td></tr>
<tr><td colspan="2">Pn6B6
Percentage when saving the gain</td><td colspan="2">Range: 1~100</td></tr>
<tr><td rowspan="2">Pn6B7
Tuning configuration function</td><td>n. □□□ 0</td><td colspan="2">None</td></tr>
<tr><td>n. □□□ 1</td><td colspan="2">When the tuning starts, automatically adjust and force the initialization of relevant functions (model tracking, type A vibration suppression, notch filter, vibration suppression)</td></tr>
</table>

Table 7-19 Mechanism selection explanation

Mechanism selection	Mechanism type
Low rigidity structure	Conveyor belt structure
Medium rigidity structure	Ball screw, linear motor
High rigidity structure	Rigid body system

7.4.1 About advanced auto-tuning 2

Advanced auto-tuning 2 is a method for automatically performing optimal adjustments to the operation command from the host controller.

Advanced auto-tuning 2 can also be used for additional adjustments after Advanced auto-tuning.

In addition, if the correct moment of inertia ratio is set in Pn103, we don't have to perform advanced auto-tuning and only perform the advanced auto-tuning 2.

Advanced auto-tuning 2 makes adjustments to the following items.

- Gain adjustment (speed loop gain, position loop gain, etc.)
- Filter adjustment (torque command filter, notch filter)
- Friction compensation
- Adjust anti-resonance control

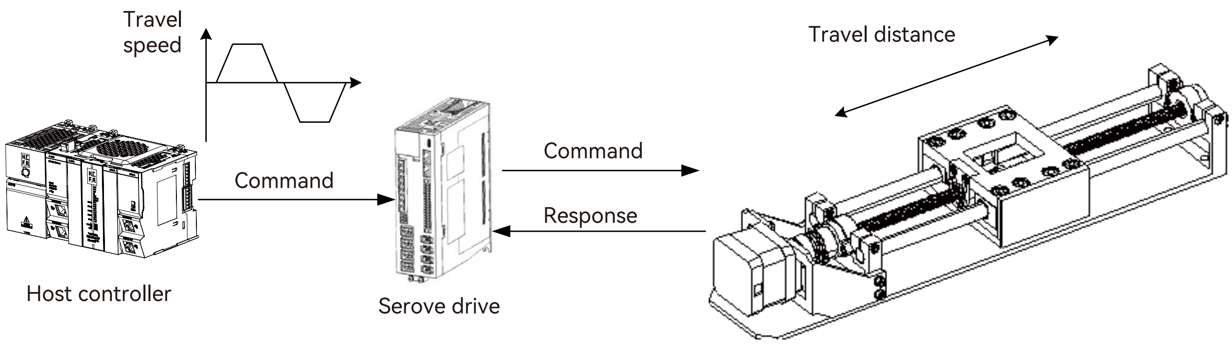


Figure 7-2 Example of automatic operation

Note: Advanced auto-tuning 2 performs automatic adjustment, so vibration or overshoot may occur during operation. To ensure safety, perform advanced tuning in a state where an emergency stop is possible at any time.

Confirmation items before operation

Before perform advanced auto tuning 2, be sure to confirm the following settings. When the following items are not correct, the "NO_OP " will display:

- The main circuit power supply must be ON
- Ther servo must be OFF
- Prohibition of forward-rotation (P-OT), prohibition of reverse-rotation (N-OT) must not be in an overtravel state
- The gain switching selection switch is manual gain switching (Pn139.0 = 0).
- The 1st gain is selected.
- No motor test function selection is invalid (Pn00C.0 = 0).
- No alarms or warnings occurred.
- Hardwired base block function (STO) does not work
- Auto gain switch must be disabled
- Write prohibition should be disabled(Fn010)
- Set the tuning-less function to be invalid (Pn170.0 = 0)
- The servbo motor is in the Position control while the servo ON.

The advanced auto tuning 2 cannot be adjusted smoothly in the following cases. Please adjust by one-parameter tuning.

- When the movement amount indicated by the upper device command is the setting value of the positioning completion width (Pn6B5) or less.

- When the moving speed commanded by the upper device is the setting value of the rotation detection value (Pn502) or less.
- When the stop time (the time during which the positioning complete signal (/COIN) is OFF) is 10ms or less.
- When the rigidity of the machine is low and vibration occurs during the positioning operation.
- When using the position integration function.
- During P (proportional) control.
- When using the mode switch.
- When the positioning completion width (Pn6B5) is narrow.

One-parameter tuning → refer to " Section 7.5 One-parameter Tuning".

Only use the overshoot detection value (Pn561) when fine-tuning the overshoot without changing the positioning completion range (Pn522). Since the default setting of Pn561 is 100%, it is allowed to adjust up to the same overshoot as the positioning completion width. If changed to 0%, the adjustment can be performed without overshoot within the positioning completion width. However, after changing this value, the positioning time may be extended.

Table 7-20 Related parameters about advanced auto resonance 1

Pn561	Overshoot detection value		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-100	1%	100		

7.4.2 Precautions for advanced auto-tuning 2

When an abnormal operation occurs during the execution of advanced auto-tuning 2, the causes and countermeasures are as follows:

If the advanced auto-tuning 2 fails, deal with it by checking the causes and countermeasures corresponding to the alarm number.

Table 7-21 Parameters about executing advanced auto-tuning 2

Parameter		Meaning	When enabled	Classification
Pn160	n. □□ 0 □	Adjust anti-resonance Control without the use of auxiliary functions	Immediately	Tuning
	n. □□ 1 □ (Default value)	Adjust anti-resonance Control with auto tunning by auxiliary function		

Table 7-22 Tuning alarm number correspondence table

Alarm No.	Cause	Countermeasure
A.9C0 Advanced automatic tuning alarm 1	Operation status error	-
A.9C2 Advanced automatic tuning alarm 3	The positioning completion signal [COIN] has not been detected for more than 10 seconds.	Increase the initial gain level of the advanced automatic tuning (Pn6B3) by one level, or increase the positioning accuracy of the advanced automatic tuning (Pn6B5) by one level.
A.9C3 Advanced automatic tuning alarm 4	The speed loop gain search has reached the lower limit.	Decrease the initial positioning accuracy of the automatic tuning (Pn6B5) by one level.
	Mechanical vibration has occurred.	The vibration can be suppressed through the type A vibration suppression adjustment function and the vibration suppression function.

A.9C4 Advanced automatic tuning alarm 5	The position loop or model loop gain search has reached the lower limit.	Increase the positioning accuracy of the advanced automatic tuning (Pn6B5) by one level.
	When the motor is stopped, the positioning completion signal (/COIN) is unstable and is turning ON/OFF.	Set "Positioning correspondence (focus on over shoot)" in the HCServoWorks startup mode. Restart the tuning, or set "L. 3" in the operation panel startup mode to restart the tuning.
	Mechanical vibration has occurred.	Suppress the vibration through the type A vibration suppression adjustment function and the vibration suppression function.
A.9C8 Advanced automatic tuning alarm 9	The torque limit value has been reached.	Increase the limit value when the torque limit is set.
		Increase the initial gain level of the automatic tuning (Pn6B3) by one level.
A.9C9 Advanced automatic tuning alarm 10	During the self-estimation process of the moment of inertia, the external input of (/P-CON) has changed the speed loop control mode to P control.	Switch to PI control during the self-estimation of the moment of inertia.
A.9CA Advanced automatic tuning alarm 11	An alarm or warning occurred in the servo during the tuning process.	Eliminate the cause of the alarm or warning and then retry.
A.9CB Advanced automatic tuning alarm 12	The servo main power is not ready during the tuning process.	Connect the main circuit power supply and then retry.
A.9CC Advanced automatic tuning alarm 13	The servo is in an over-travel state during the tuning process.	Eliminate the cause of the over-travel and then retry.
A.9CD Advanced automatic tuning alarm 14	The servo is not enabled during the tuning process.	Do not perform the servo enable OFF operation during the tuning operation.
A.9CE Advanced automatic tuning alarm 15	The currently effective gain of the servo during the tuning process is not the first gain.	Set the automatic gain switching to invalid (Pn139.0 = 0) and the G-SEL to the OFF state.
A.9CF Advanced automatic tuning alarm 16	The servo is in the STO state during the tuning process.	Release the STO state and then retry.
A.9D2 Advanced automatic tuning alarm 19	The saving of the gain result failed after the tuning was completed.	Do not perform other parameter writing operations during the tuning process and then retry.
A.9D3 Advanced automatic tuning alarm 19	The downstream command from the host computer timed out during the tuning process.	Check whether the USB connection is good or replace the USB cable and then retry.

Note: If a tuning-related warning occurs, there is no need to manually clear it. Just restart the tuning.

7.5 One-parameter tuning

This section explains how to adjust by one-parameter tuning

7.5.1 About one-parameter tuning

One-parameter tuning is a method of manually adjusting a speed command or a position command from a host device while running.

Adjusting one or two values through One-parameter tuning automatically adjusts the setting value of the associated gain.

One-parameter tuning has the following items.

- Gain adjustment (speed loop gain, position loop gain, etc.).
- Filter adjustment (torque command filter, notch filter).

- Friction compensation.
- Adjust anti-resonance control.

< Supplement >

If the response characteristics cannot be obtained with advanced auto tuning 1 or advanced auto tuning 2, use one-parameter tuning.

In addition, if you want to further fine-tune servo gain after one-parameter tuning, please refer to "Adjustment application function"

Note: Vibration or overshoot may occur during adjustment. To ensure safety, perform advanced tuning in a state where an emergency stop is possible at any time.

Confirmation items before execution:

Before perform one-parameter tuning, be sure to confirm the following settings. When the following items are not set, "NO_OP" will display:

- The test without a motor function must be disabled (Pn00C.0 = 0).
- Write prohibition should be disabled(Fn010).
- Set the tuning-less function to be invalid (Pn170.0 = 0).
- When performing tuning by speed control, set the tuning mode to 0 or 1.

7.5.2 Operation steps for one-parameter tuning

The operation steps of one-parameter tuning are as follows.

According to the selected adjustment mode, there are two operation procedures for One-parameter tuning.

- When Mode = 0 or 1 -Model tracking control is "invalid", and make adjustments except positioning.
- When Mode = 2 or 3 - Model tracking control is "valid", and make adjustments of positioning.

The operation of one-parameter tuning can be executed through the operation panel or HCServoWorks.

However, the operation panel can only be operated when the tuning mode is set to "Mode = 0", "Mode = 1".

Please operate after setting the moment of inertia ratio (Pn103) correctly by advanced auto tuning.

7.6 Supplements for auto-tuning

7.6.1 Supplements for function

Automatic notch filter function:

Normally, please set to "Auto-tuning" (Default value: "Auto-tuning").

When set to "Auto-tuning", vibration will be detected automatically when this function is executed, and the notch filter will be adjusted.

Please set to "No auto-tuning" only when you do not change the notch filter setting.

Table 7-23 Parameters for automatic notch filter

Parameter		Meaning	When enabled	Classification
Pn460	n. □□□ 0	Auto tuning of the 1st-stage notch filter without auxiliary functions	Immediately	Tuning
	n. □□□ 1 (Default value)	Auto tuning of the 1st-stage notch filter by auxiliary function		
	n. □ 0 □□	Auto tuning of the 2nd-stage notch filter without auxiliary functions		
	n. □ 1 □□ (Default value)	Auto tuning of the 2nd-stage notch filter by auxiliary function		

Adjust anti-resonance control function:

Normally, please set to "Auto-tuning" (Default value: "Auto-tuning")

When set to "Auto-tuning ", vibration is automatically detected during advanced auto-tuning, and adjust anti-resonance control is automatically adjusted.

Table 7-24 Parameters about adjust anti-resonance control

Parameter		Meaning	When enabled	Classification
Pn160	n. □□ 0 □	Auto tuning of adjust anti-resonance control without auxiliary functions	Immediately	Tuning
	n. □□ 1 □ (Default value)	Auto tuning of adjust anti-resonance control with auxiliary function		

Vibration suppression function:

The vibration suppression function is mainly used to suppress the low-frequency vibration (shaking) of about 1 to 100 Hz caused by the vibration of the machine during positioning.

Normally, please set to "Auto-tuning" (Default value: "Auto-tuning").

When set to "Auto-tuning", vibration is automatically detected during advanced auto-tuning, and vibration suppression control is automatically adjusted.

Set to "No auto-tuning" only when you do not change the vibration suppression control setting that was set before executing advanced auto tuning.

Table 7-25 Parameters about vibration suppression function

Parameter		Meaning	When enabled	Classification
Pn140	n. □ 0 □□	Auto tuning of vibration suppression function without auxiliary functions	Immediately	Tuning
	n. □ 1 □□ (Default value)	Auto tuning of vibration suppression function with auxiliary function		

Feedforward function:

- Lubricant viscous resistance changes in machine sliding parts
- Frictional resistance change caused by mechanical assembly deviations
- Frictional resistance change due to aging

The applicable conditions for friction compensation differ depending on the mode . "Mode= 1" follows the setting of "Friction compensation function selection (Pn408.3)". "Mode = 2" or "Mode = 3" has nothing to do with the setting of "Friction compensation function selection (Pn408.3)", and can be adjusted through "Valid friction compensation function ".

Table 7-26 Parameters for friction compensation function

Friction compensation function selection \ Mode		"Mode = 1"	"Mode = 2"	"Mode = 3"
Pn408	n.0 □□□ (Default value)	Adjust when friction compensation is invalid	Adjust when friction compensation is valid	Adjust when friction compensation is valid
	n.1 □□□	Adjust when friction compensation is valid		

Feedforward function:

After adjustment by "Mode= 2" and "Mode = 3" in the default setting mode, "Feedforward (Pn109)", "Speed feedforward (V-REF) input" and "Torque feedforward (T- REF) input" will become invalid.

According to the system configuration, if you want to use the "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" and "Model tracking control" from the upper device at the same time, please set Pn140.3 = 1.

Table 7-27 Parameters for feedforward function

Parameter		Meaning	When enabled	Classification
Pn140	n.0 □□□ (Default value)	Do not use model tracking control and speed/torque feedforward simultaneously	Immediately	Tuning
	n.1 □□□	Using model tracking control and speed/ torque feedforward simultaneously		

Note: When using the model tracking control under this function, the model tracking control will have the best feedforward inside the servo. Therefore, usually do not use "Speed feedforward (V-REF) input " and "Torque feedforward (T-REF) input " from the upper device at the same time. However, Model tracking control and "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" can be used at the same time as required. In this cas , if the input feed-forward is not correct, it may cause overshoot, please pay attention.

7.6.2 Related parameters

Related parameters are listed in Table 7-28 below.

- Parameters related to this function

The parameters used or referenced when executing this function.

- Whether to change the setting value of the parameter when executing this function.

"No": When executing this function, parameters cannot be changed through HCServoWorks, etc.

"Yes": Parameters can be changed through HCServoWorks, etc. when executing this function.

- Whether there is automatic setting of parameters after executing this function

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-28 Parameters related to one-parameter tuning

Parameter	Name	Is it possible to change the setting value	Automatic setting
Pn100	Speed loop gain	No	Yes
Pn101	Speed loop integral time constant	No	Yes
Pn102	Position loop gain	No	Yes
Pn103	Moment of inertia ratio	No	No
Pn121	Friction compensation gain	No	Yes
Pn123	Friction compensation coefficient	No	Yes
Pn124	Friction compensation frequency correction	No	No

Pn125	Friction compensation gain correction	No	Yes
Pn401	1st stage 1st torque command filter time constant	No	Yes
Pn408	Torque-related function selections	Yes	Yes
Pn409	1st stage notch filter frequency	No	Yes
Pn40A	1st stage notch filter Q value	No	Yes
Pn40C	2nd stage notch filter frequency	No	Yes
Pn40D	2nd stage notch filter Q value	No	Yes
Pn140	Model following control-related selections	Yes	Yes
Pn141	Model following control gain	No	Yes
Pn142	Model following control gain correction	No	Yes
Pn143	Model following control bias in the forward direction	No	Yes
Pn144	Model following control bias in the reverse direction	No	Yes
Pn145	Vibration suppression 1 frequency A	No	Yes
Pn146	Vibration suppression 1 frequency B	No	Yes
Pn147	Model following control speed feedforward compensation	No	Yes
Pn160	Anti-resonance control-related selections	Yes	Yes
Pn161	Anti-resonance frequency	No	Yes
Pn163	Anti-resonance damping gain	No	Yes

7.7 Adjust anti-resonance control function

This section describes the Adjust anti-resonance control function.

7.7.1 About adjust anti-resonance control function

About adjust anti-resonance control function is used to further improve the effect of vibration suppression after the one-parameter tuning.

AAbout adjust anti-resonance control function can effectively suppress the continuous vibration of about 100-1000Hz that occurs when the control gain is increased.

This function will be automatically set by advanced auto-tuning or advanced auto-tuning 2. So use this function only when further fine-tuning is required and when re-adjustment is required due to vibration detection failure.

After executing this function, if want to improve the response, perform one-parameter tuning, etc. Vibration may reoccur after the anti-vibration gain is increased by one-parameter tuning, etc. At this time, please execute this function again to make minor adjustments.

Note: • After executing this function, relevant parameters will be set automatically. Therefore, when this function is executed, the response may change greatly. For the sake of safety, please execute this function in the state of emergency stop at any time.

• Before executing the adjust anti-resonance control function, please correctly set the moment of inertia ratio (Pn103) through advanced auto-tuning, etc. Otherwise, vibration may occur. .

• The vibration frequency range that can be detected by this function is 100Hz to 1,000Hz. Vibration outside the detection range cannot be detected, and "F----" is displayed. In this case, set the notch filter automatically with "Mode = 2" of one-parameter tuning, or use the vibration suppression function.

• Increasing the A-type anti-vibration damping gain (Pn163) can improve the vibration suppression effect, but if the damping gain is too large, the vibration may be increased instead. While checking the vibration suppression effect, gradually increase the damping gain setting value in units of 10% within the range of 0% to 200%. If the vibration suppression effect cannot be obtained even after the damping gain reaches 200%, please stop the setting and reduce the control gain through one-parameter tuning, etc.

Confirmation items before execution:

Before executing adjust anti-resonance control, be sure to confirm the following settings. When the following items are not set, "NO_OP" will display:

- Select tuning-less function to be invalid (Pn170.0 = 0) .

- The test without a motor function must be disabled (Pn00C.0 = 0).
- Torque control is not allowed.
- Write Prohibition should be disabled(Fn010) .

7.7.2 Operation steps of anti-resonance control function

Execute this function when vibration occurs after inputting an action command

Aanti-resonance control function can be done through HCServoWorks. This function cannot be operated through the operation panel.

Operation steps of adjust anti-resonance control function are as follows.

- When using the adjust anti-resonance control function for the first time.
- When the vibration frequency is unknown.
- When the vibration frequency is known.
- When making further fine-tuning after using the adjust anti-resonance control function.

7.7.3 Related parameters

Related parameters are shown in table 7-29 below.

- Parameters related to the function.

The parameters used or referenced when executing this function.

- Whether to change the setting value of the parameter when executing this function.

"No": When executing this function, parameters cannot be changed through HCServoWorks, etc.

"Yes": When executing this function, parameters can be changed through HCServoWorks, etc..

- Whether there is automatic setting of parameters after executing this function.

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-29 Parameters for anti-resonance control function

Parameter	Name	Is it possible to change the setting value	Automatic setting
Pn160	Anti-resonance control-related selections	Yes	Yes
Pn161	Anti-resonance frequency	No	Yes
Pn162	Anti-resonance gain correction	Yes	No
Pn163	Anti-resonance damping gain	No	Yes
Pn164	Anti-resonance filter time constant 1 correction	Yes	No
Pn165	Anti-resonance filter time constant 2 correction	Yes	No

7.8 Vibration suppression function

This section explains the vibration suppression function.

7.8.1 About the vibration suppression function

The vibration suppression function is mainly used to suppress the low-frequency vibration (shaking) of about 1-100 Hz caused by the vibration of the machine during positioning.

This function will be automatically set by advanced auto-tuning 1 or advanced auto-tuning 2. Only use this function when further fine-tuning and re-adjustment is required due to vibration detection failure.

After executing this function, please perform one-parameter tuning to improve the response.

Note: • After executing this function, related parameters will be set automatically. But the response may change greatly. For safety, please execute this function in a state where an emergency stop is possible at any time.

• Before executing this function, correctly set the moment of inertia ratio (Pn103) by advanced auto tuning, etc. Otherwise, vibration may occur.

• The vibration frequency range that can be detected by using this function is 1~100Hz. Vibration outside the detection range cannot be detected, and "F-----" is displayed.

• Vibration cannot be detected if there is no vibration due to positional deviation, or if the vibration frequency is outside the detection frequency range. In this case, please use a displacement meter or a vibration meter to measure the vibration.

• When the vibration cannot be eliminated with the automatically detected vibration frequency, there may be an error between the actual vibration frequency and the detected frequency, please fine-tune the vibration frequency.

---

(1) Confirmation items before execution

Before executing the vibration suppression function, be sure to confirm the following settings. When the following items are not set, "NO_OP"will display:

- In position control.
- Set the tuning-less function to be invalid (Pn170.0 = 0) .
- The test without a motor function must be disabled (Pn00C.0 = 0).
- Write prohibition should be disabled(Fn010) .

(2) Items affecting performance

Sufficient vibration suppression effect cannot be obtained by the vibration suppression function for vibrations that continue to occur during a stop. In this case, adjust with the adjust anti-resonance control or one-parameter tuning.

(3) About the detection of vibration frequency

Frequency detection may not be possible if vibration does not appear in the position deviation or the vibration that results from the position deviation is too small. You can adjust the detection sensitivity by changing the setting of the residual vibration detection width (Pn560), which is set as a percentage of the positioning completed width (Pn522). Perform the detection of vibration frequencies again after adjusting the setting of Pn560.

Table 7-30 Parameter settings for vibration frequency detection

Pn560	Residual vibration detection width		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	1-3000	0.1%	400		

Note: As a guideline, change the setting 10% at a time. If the setting of this parameter is lowered, the detection sensitivity will be increased. Vibration may not be detected accurately if the setting is too small. The vibration frequencies that are automatically detected may vary somewhat with each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

7.8.2 Precautions for vibration suppression function

The operation procedure of the vibration suppression function is as follows.

The operation of the vibration suppression function can be performed through HCServoWorks. This function cannot be operated through the operation panel.

Suppliments for the vibration suppression function:

Feedforward function:

In the default setting mode, "Feedforward (Pn109)", "Speed feedforward input (V-REF) " and "Torque feedforward (T-REF) input" will become invalid.

According to the system configuration, if you want to use the "Speed feedforward input (V-REF)" and "Torque feedforward input(T-REF) " from the host device and model tracking control at the same time, please set Pn140.3 = 1.

Table 7-31 Parameters for feedforward function

Parameter		Contents	When enabled	Classification
Pn140	n.0 □□□ (Default value)	Do not use Model tracking control and Speed/torque feedforward simultaneously	Immediately	Tuning
	n.1 □□□	Using Model tracking control and Speed/torque feedforward simultaneously		

Note: When using the model following control under this function, the best feedforward will be set inside the servo.

Therefore, generally do not use the "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" from the host device at the same time.

However, Model following control and "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" can be used at the same time as required.

At this time, if the input feedforward is incorrect, it may cause overshoot.

7.8.3 Related parameters

Related parameters are shown in table 7-32 below.

- Parameters related to this function

The parameters used or referenced when executing this function.

- Is it possible to change the setting value of the parameter when executing this function?

"No": When executing this function, parameters cannot be changed through HCServoWorks, etc.

"Yes": Parameters can be changed through HCServoWorks, etc. when executing this function.

- Whether there is automatic setting of parameters after executing this function

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-32 Parameters for Vibration Suppression Function

Parameter	Name	Is it possible to change the setting value	Automatic setting
Pn140	Model following control-related selections	Yes	Yes
Pn141	Model following control gain	No	Yes
Pn142	Model following control gain correction	No	No
Pn143	Model following control bias in the forward direction	No	No
Pn144	Model following control bias in the reverse direction	No	No
Pn145	Vibration suppression 1 frequency A	No	Yes
Pn146	Vibration suppression 1 frequency B	No	Yes
Pn147	Model following control speed feedforward compensation	No	No
Pn14A	Vibration suppression 2 frequency	No	No
Pn14B	Vibration suppression 2 correction	No	No

7.9 Adjustment application function

The following describes the functions for further individual adjustments after advanced auto-tuning 1, advanced auto-tuning 2, and one-parameter tuning.

- Gain switching.
- Friction compensation function.
- Current control mode selection.
- Current gain value setting.
- Speed detection method selection.

7.9.1 Gain switching

The gain switching function includes "Manual gain switching" that uses an external input signal and "Auto gain switching".

By using the gain switching function, the gain can be increased during positioning to shorten the positioning time, and the gain can be decreased to suppress vibration when the servo motor is stopped.

Table 7-33 Parameters for gain switching

Parameter		Contents	When enabled	Classification
Pn139	n. □□□ 0 (Default value)	Manual gain switching	Immediately	Tuning
	n . □□□ 2	Auto gain switching		

Note: 1. n. □□□ 1 is a reserved parameter (Do not set).

2. For gain switching combinations, please refer to "1) Gain switching combinations".

3. For manual gain switching, please refer to "2) Manual gain switching".

4. For the auto gain switching, please refer to "(3) Auto gain switching".

(1) Gain switching combinations

Table 7-34 Gain switching combinations

Gain switching	Speed loop gain	Speed loop integral time constant	Position loop gain	Torque command filter	Model tracking control gain*	Model tracking control gain correction*	Friction compensation gain
1st gain	Speed loop gain (Pn100)	Speed loop integral time constant (Pn101)	Position loop gain (Pn102)	Filter time constant of 1st stage 1st torque command (Pn401)	Model tracking control gain (Pn141)	Model tracking control gain correction (Pn142)	Model friction compensation gain (Pn121)
2nd gain	2nd speed loop gain (Pn104)	2nd speed loop integral time constant (Pn105)	2nd position loop gain (Pn106)	Filter time constant of 1st stage 2nd torque command (Pn412)	2nd model tracking control gain (Pn148)	2nd model tracking control gain correction (Pn149)	2nd model friction compensation gain (Pn122)

*The gain switching of model tracking control gain and model tracking control gain correction is only applicable to "Manual switching gain".

In addition, the gain is switched only when the following conditions are satisfied at the same time and the gain switching signal is input. When the conditions are not met, even if other parameters in the above table are switched, these parameters will not be switched.

- No command
- The servo motor stops

(2) Auto gain switching

"Auto gain switching " is only valid at position control. The switching conditions are executed with the following settings.

Table 7-35 Parameters for auto gain switching

Parameter		Switch condition	Switching gain	Waiting time	Switching time
Pn139	n. □□□ 2	Condition A satisfied	1st gain 2nd gain	Waiting time 1 Pn135	Switching time 1 Pn131
		Condition A not satisfied	2nd gain 1st gain	Waiting time 2 Pn136	Switching time 2 Pn132

Select "Switching condition A" for auto gain switching from the following settings.

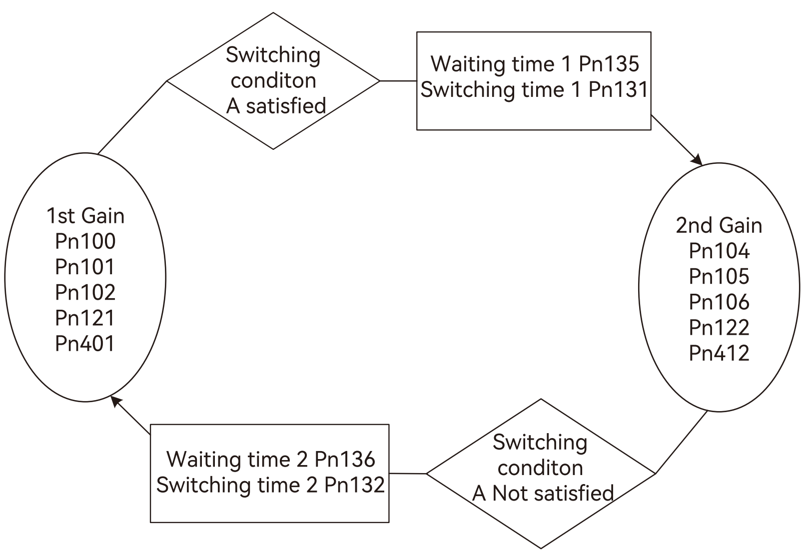
Table 7-36 "Switching condition A" parameters of auto gain switching

Parameter		Position control Switching condition A	Other than position control (no switching)	Waiting time	Switching time
Pn139	n. □□ 0 □ (Default value)	Positioning completion signal (/COIN) ON	Fixed at 1st gain	Immediately	Tuning
	n. □□ 1 □	Positioning completion signal (/COIN) OFF	Fixed at 2nd gain		
	n. □□ 2 □	Positioning proximity signal (/NEAR) ON	Fixed at 1st gain		
	n. □□ 3 □	Positioning proximity signal (/NEAR) OFF	Fixed at 2nd gain		
	n. □□ 4 □	Position command filter output = 0 And the command pulse input is OFF	Fixed at 1st gain		
	n. □□ 5 □	Position command pulse input ON	Fixed at 2nd gain		

*Auto switching mode 1 (Pn139.0=2)

Relationship between waiting time and switching time at gain switching

For example, assume where the position loop gain Pn102 is switched to the 2nd position loop gains Pn106 in the auto gain switching mode conditional on the positioning completion signal (/COIN) ON. The /COIN signal of the switching condition is ON, and the gain is linearly changed from Pn102 to Pn106 during the switching time Pn131 after waiting for the waiting time Pn135 from the time when the switching condition is satisfied.



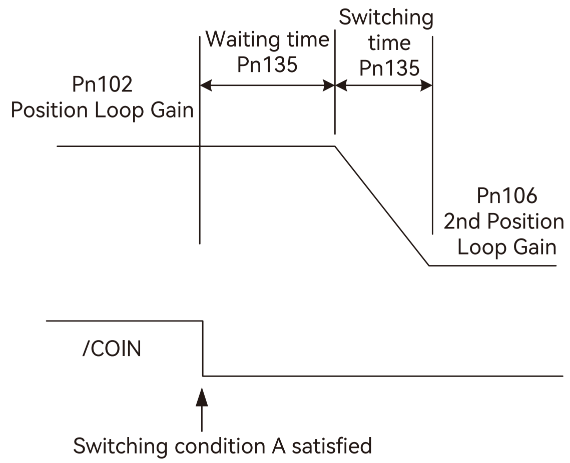


Figure 7-3 Relationship between waiting time and switching time at gain switch

Note: Gain switching can be executed under PI or IP control mode (Pn10B).

(3) Related parameters

Table 7-37 Parameters for adjustment application function

Parameter	Meaning	When enabled	Classification
Pn100	Speed loop gain	Immediately	Tuning
Pn101	Speed loop integral time constant		
Pn102	Position loop gain		
Pn401	1st stage 1st torque command filter time constant		
Pn141	Model following control gain		
Pn142	Model following control gain correction		
Pn121	Friction compensation gain		
Pn104	2nd speed loop gain		
Pn105	2nd speed loop integral time constant		
Pn106	2nd position loop gain		
Pn412	1st stage 2nd torque command filter time constant		
Pn148	2nd model following control gain		
Pn149	2nd model following control gain correction		
Pn122	2nd friction compensation gain		

(4) Related parameters for auto gain switching

Table 7-38 Parameters related to auto gain switching

Parameter	Meaning	When enabled	Classification
Pn131	Gain switching time 1	Immediately	Tuning
Pn132	Gain switching time 2		
Pn135	Gain switching waiting time 1		
Pn136	Gain switching waiting time 2		

(5) Related monitoring

Table 7-39 Monitoring No. related to auto gain switching

Monitoring No.	Monitoring name	Display value	Content
Un014	Active gain monitor	1	Displayed when the 1st gain is valid
		2	Displayed when the 2nd gain is valid

Note: "1" is displayed when the tuning-less function is valid.

Table 7-40 Monitoring parameters related to auto gain switching

Parameter	Analog monitoring	Monitoring name	Output value	Content
Pn006 Pn007	n. □□ 0B	Active gain monitor	1V	The 1st gain is valid
			2V	The 2nd gain is valid

7.9.2 Manual adjustment of friction compensation

The friction compensation function is to correct viscous friction fluctuations and fixed load fluctuations.

The friction compensation function can be automatically adjusted through advanced auto-tuning 1, advanced auto-tuning 2, and One-parameter tuning. The following describes the procedure when manual adjustment is required.

(1) Parameters to be set

To use the friction compensation function, the following parameters need to be set.

Table 7-41 Parameters for friction compensation function

Parameter		Meaning	When enabled	Classification
Pn408	n.0 □□□ (Default value)	Without friction compensation function	Immediately	Tuning
	n.1 □□□	Use friction compensation function		

Table 7-42 Parameters for friction compensation function

Parameter	Meaning	When enabled	Classification
Pn121	Friction compensation gain	Immediately	Tuning
Pn123	Friction compensation coefficient		
Pn124	Friction compensation frequency correction		
Pn125	Friction compensation gain correction		

(2) Operation steps of friction compensation function

The operation steps of the friction compensation function are as follows.

Note: When using the friction compensation function, please set the moment of inertia ratio (Pn103) as correctly as possible. If the moment of inertia ratio is incorrect, it may cause vibration.

① Restore the following parameters related to friction compensation to the default settings.

Friction compensation gain (Pn121) → Default value: 100

Friction compensation coefficient (Pn123) → Default value: 0

Friction compensation frequency correction (Pn124) → Default value: 0

Friction compensation gain correction (Pn125) → Factory setting: 100

Note: Please make the friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125) always be the default settings.

② To confirm the effect of the friction compensation function, please increase the friction compensation coefficient (Pn123) gradually.

Note: Normally, please set the setting value of the friction compensation coefficient (Pn123) below 95%. If the effect is not obvious enough, please increase the setting value of the friction compensation gain (Pn121) by 10% within the range of no vibration

The effect of adjusting parameters:

Pn121: Friction compensation gain

Set parameters of response to external disturbances. The higher the setting value, the better the response to external disturbance, but if the setting value is too high, vibration may occur when the device has a resonance frequency.

Pn123: Friction compensation coefficient

Sets the parameters for the friction compensation effect. The higher the setting value, the better the effect, but if the setting value is too high, the response is more likely to vibrate. Generally, please set the setting value below 95%.

③ Adjustment effect: The adjustment result is shown as follows in the form of waveform diagrams before and after adjustment.

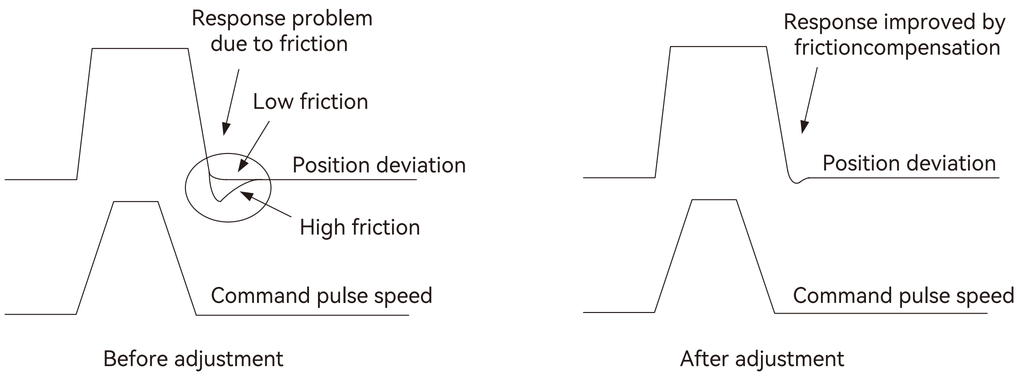


Figure 7-4 Waveforms to adjustment results before and after adjustment

7.9.3 Current control mode selection function

The current control mode selection function can reduce the high-frequency noise during the servo motor stop. The models can use this function are as follows. This function is valid in the default setting mode, and is set as a valid condition in many occasions. When using this function, please set Pn009.1 = 1.

Table 7-43 Parameters for current control mode selection function

Parameter		Meaning	When enabled	Classification
Pn009	n. □□ 0 □	Select current control mode 1	Restart the power supply	Tuning
	n. □□ 1 □ (Factory setting)	Select current control mode 2 (low noise)		

7.9.4 Current gain value setting function

The current gain value setting function is to adjust the current control parameters inside the servo drive according to the speed loop gain (Pn100) to reduce noise. By reducing the current gain value (when Pn13D is 2000 , the current gain is the internal setting value), the noise level can be reduced. But at the same time, it will cause the response characteristics of the servo drive. Therefore, please adjust within the range that can ensure the response characteristics. In addition, it is invalid during torque control (Pn000.1 = 2).

Points	• Selecting power supply control mode 2 may increase the load rate which is in stop.

Table 7-44 Parameters for current gain value setting function

Pn13D	Current gain value	Speed Position Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	100~2000	1%	2000		

Note: After changing this function, the response characteristics of the speed loop will also change, so it is necessary to re-adjust the servo.

7.9.5 Speed detection method selection

The speed detection method selection can smooth the servo motor speed during operation. Please set Pn009.2 = 1 and select Speed detection 2 to make the motor speed smooth.

Table 7-45 Parameters for speed detection method selection

Parameter		Meaning	When enabled	Classification
Pn009	n. □ 0 □□ (Default value)	Select speed detection 1	Restart the power supply	Tuning
	n. □ 1 □□	Select speed detection 2		

Note: After changing the speed detection method, the response characteristics of the speed loop will also change, so it is necessary to re-adjust the servo.

7.10 Other adjustments functions

7.10.1 Feedforward

Feedforward is the function of performing feedforward compensation to shorten the positioning time during Position control.

Table 7-46 Parameters for Feedforward

Pn109	Feedforward		Position	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0~100	1%	0		
Pn10A	Feedforward filter time constant		Position	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-6400	0.01ms	0		

Note: If the feed-forward setting value is too large, it may cause mechanical vibration. Please lower the setting value to 80% or less.

7.10.2 Setting mode switch (P control/PI control switching)

The Mode switch is a function to automatically switch between P control and PI control.

Set switching conditions through Pn10B.0, and P control starts when the setting values of Pn10C, Pn10D, Pn10E, and Pn10F are exceeded.

If switching conditions and condition values are set, overshoot can be suppressed during acceleration and deceleration and the settling time can be shortened.

(1) Related parameters

Select the switching condition of the Mode switching through Pn10B.0.

Table 7-47 Parameters for setting mode switching

Parameter		Select mode switch	Parameters that set conditional values	When enabled	Classification
Pn10B	n. □□□ 0 (Default value0)	Conditional on internal torque command	Pn10C	Immediately	Setup
	n. □□□ 1	Conditional on speed command	Pn10D		
	n. □□□ 2	conditional on acceleration	Pn10E		
	n. □□□ 3	Conditional on positional deviation	Pn10F		
	n. □□□ 4	Mode switching not selected	-		

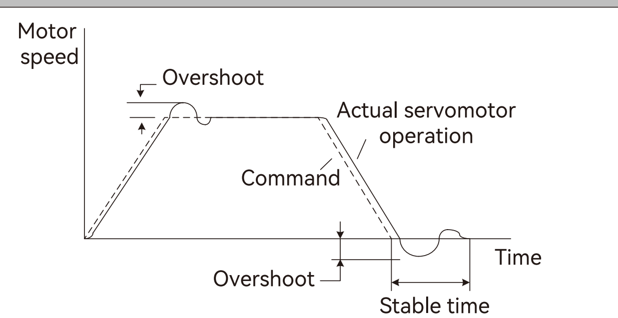
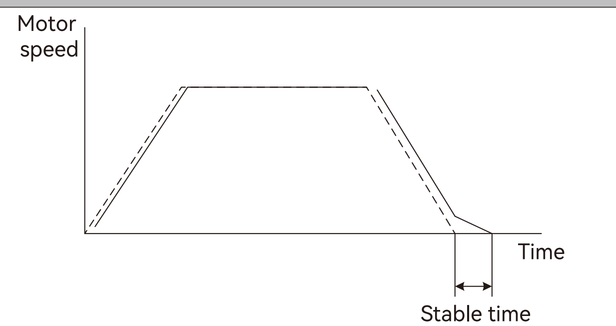
Table 7-48 Parameters for setting switching condition

Parameter	Meaning	When enabled	Classification
Pn10C	Mode switching level for torque command	Immediately	Tuning
Pn10D	Mode switching level for speed command		
Pn10E	Mode switching level for acceleration		
Pn10F	Mode switching level for position deviation		

Example: When the switching condition of the mode switching is used as the torque command (default setting)

When the torque command exceeds the torque set in Pn10C, the speed loop will switch to P control.

The torque command value is set to 200% at the factory.

No mode selection	With mode selection
	

7.10.3 Torque command filter

A delay filter and a notch filter are serially configured in the torque command, and they act independently.

The notch filter is enabled/disabled through Pn408.

(1) Torque command filter

If the vibration of the machine may be caused by the servo drive, if the following torque command filter time parameters are adjusted, the vibration may be eliminated. The smaller the value, the better the response, but it is limited by the mechanical conditions.

Table 7-49 Parameters for torque command filter

Pn401	1st stage 1st torque command filter time constant		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Tuning
	0~65535	0.01ms	100		

Setting standard of torque command filter

- Speed loop gain (Pn100[Hz]) and torque filter time constant (Pn401[ms])
- Adjustment value of stable control range Pn401[ms] $\leq 1000/(2\pi \text{Pn100[Hz]} \cdot 4)$
- Limit adjustment value Pn401[ms] $< 1000/(2\pi \cdot \text{Pn100[Hz]} \cdot 1)$

Table 7-50 Parameters for filter frequency of the 2nd stage 2nd torque command

Pn40F	2nd stage 2nd torque command filter frequency		Speed / Position / Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Tuning
	100~5000	1Hz	5000		

Table 7-51 Parameters for 2nd stage 2nd torque command filter Q value

Pn410	2nd stage 2nd torque command filter Q value		Speed / Position / Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Tuning
	50~100	0.01ms	50		

Note: When set to 5000, the filter becomes invalid.

2) Notch filter

The notch filter is a filter used to eliminate specific vibration frequency components caused by resonance of the ball screw shaft, etc.

The gain curve is shown in the figure below, and a specific frequency (hereinafter referred to as the notch frequency) is in the shape of a notch, which can reduce or eliminate the notch frequency.

The larger the value of the Q value of the notch filter, the more severe the notch and phase delay.

Note: Select the notch filter to be valid/invalid through Pn408.

Table 7-52 Parameters for the validity/invalidity of notch filter

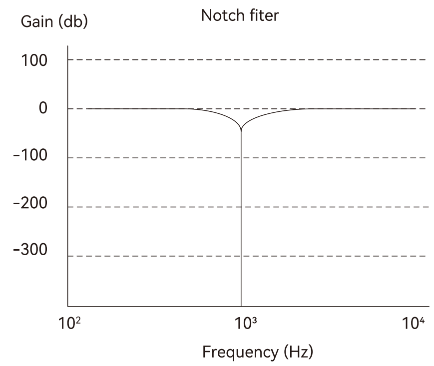
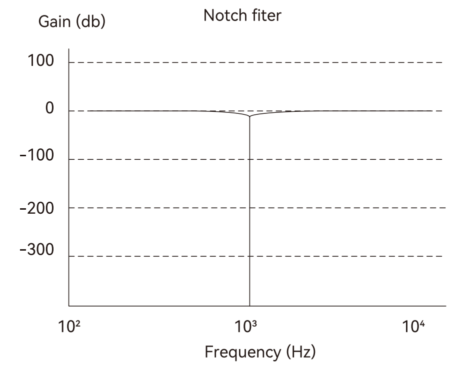
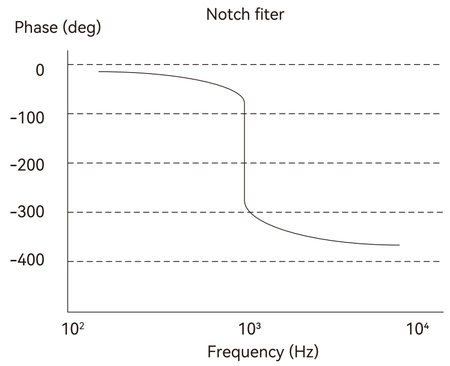
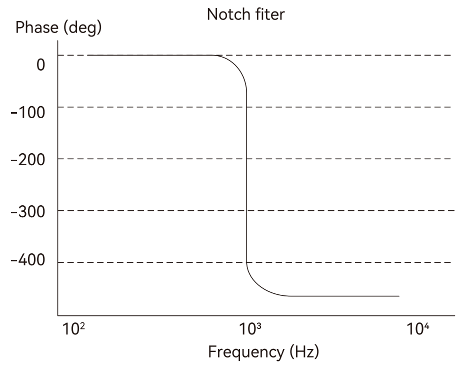
Parameter		Meaning	生效时刻	Classification
Pn408	n. □□□ 0 (Default value)	Disable the 1st stage notch filter	Immediately	Setup
	n. □□□ 1	Enable the 1st stage notch filter		
	n. □ 0 □□ (Default value)	Disable the 2nd stage notch filter		
	n. □ 1 □□	Enable the 2nd stage notch filter		

Table 7-53 Notch filter parameters by mechanical vibration frequency

Parameter	Meaning	When enabled	Classification
Pn409	1st stage notch filter frequency	Immediately	Tuning
Pn40A	1st stage notch filter Q value		
Pn40B	1st stage notch filter depth		
Pn40C	2nd stage notch filter frequency		
Pn40D	2nd stage notch filter Q value		
Pn40E	2nd stage notch filter depth		

Note: 1. Do not set the notch filter frequency (Pn409 or Pn40C) close to the response frequency of the speed loop. At least this frequency should be set as 4 times of the speed loop gain (Pn100) (but Pn103 should be set correctly). Incorrect setting may cause mechanical damage due to vibration.

2. Be sure to change the notch filter frequency (Pn409 or Pn40C) when the servo motor stop. If making changes while the servo motor isrunning, it may cause vibration.

Q value = 0.7	Q value = 1.0
	
	

Chapter 8 Auxiliary Functio

8.1 Auxiliary function list

Auxiliary functions refer to functions related to the operation and adjustment of the servo motor.

Displayed as a number starting with Fn on the operation panel.

In 730W, press the Axis Switch key to change the axis number. The auxiliary functions and operation steps are identical for all axes.

The following table lists the overview and reference items of auxiliary functions.

Table 8-1 List of auxiliary functions

Fn No.	Function	Operation of the operation panel	By HCServoWorks	Reference chapter
Fn000	Display alarm history	1	1	8.2
Fn001	Simple rigidity selection	1	1	8.3
Fn002	JOG	1	1	8.4
Fn003	Origin search	1	1	8.5
Fn004	Jog program	1	1	8.6
Fn005	Initialize parameters	1	1	8.7
Fn006	Clear alarm history	1	1	8.8
Fn008	Setting (initialization) of the absolute encoder and encoder alarm reset	1	1	8.9
Fn00E	Auto tuning motor current detection signal offset	1	1	8.10
Fn00F	Manually adjust motor current detection signal offset	1	1	8.11
Fn010	Write prohibition setting	1	0	8.12
Fn011	Display servomotor model	0	1	8.13
Fn012	Display software version	1	1	8.14
Fn01B	Initialize vibration detection level	0	1	8.15
Fn030	Software reset	1	1	8.16
Fn080	Magnetic pole detection	1	1	8.17
Fn082	Current JOG	1	1	8.18
Fn200	Tuning-less level setting	1	1	8.19
Fn201	Advanced auto tuning	1	1	8.20
Fn202	Advanced auto tuning with command	0	1	8.21
Fn203	One-parameter tuning	1	1	8.22
Fn204	Adjust anti-resonance control	0	1	—
Fn205	MFC vibration detection	0	1	—
Fn206	EasyFFT	1	1	8.23
Fn207	Auto vibration detection	0	1	—

1: Operable 0: Not operable

8.2 Display of alarm record (Fn000)

The servo drive has a retroactive display function, which can display up to 10 alarm records that have occurred.

The number and time stamp of the alarm occurrence can be confirmed.

Time stamp is a function that measures the duration after the control power supply and main circuit power supply are turned on in units of 100ms, and displays the total operating time when an alarm occurs.

If it is operated 24 hours a day, 365 days a year, it can be continuously measured for about 13 years.

< Time stamp display example>

When displaying 36000

36000x100 [ms]=3600 [s]=60 [min]=1 [h]

So the total run time is 1 hour.

The procedure for displaying alarm records is as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Long-press S for 1 sec., and the latest alarm will be displayed.

③ After short-pressing S , the lower 4 digits of the alarm time stamp will be displayed, and short-press S to display the middle 4 digits of the alarm time stamp, then short-press S once to display the highest 2 digits of the alarm time stamp. Then short-press S again to display the alarm record currently viewed.

④ Press the ∧ key to display the previous alarm. Press ∨ key to display the new alarm. The higher the number in the leftmost digit, the older the alarm displayed.

⑤ Press the S for about 1 sec, then return to the auxiliary function" Fn000 ".

<Supplements>

• When the same alarm occurs continuously, if the interval between error occurrences is less than 1 hour, it will not be saved, and if it exceeds 1 hour, the alarm will be saved.

• "口._ _ _ " is displayed on the operation panel.

CAUTION ⚠

• The overtravel prevention function is invalid during JOG operation. While operating, the operating range of the machinery used must be considered.

• Alarm records can only be deleted through " Clear Alarm History (Fn006)". Even if the alarm is reset or the main circuit power of the servo drive is cut off, the alarm history cannot be deleted.

8.3 Simple rigidity selection (Fn001)

The operation steps for the simple rigidity selection (Fn001) are as follows:

① Press the M on the panel to select the auxiliary function Fn000, and the panel displays " Fn000 ",

② Press the ∧ or ∨ , and the panel displays " Fn001 ",

③ Press the S for about 1 second, and the panel displays " d.0001 ",

④ Press the ∧ or ∨ to adjust the offset value.

⑤ After pressing the M , the panel displays " donE " which flashes for about 1 second, and then the panel displays " d.00XX ".

⑥ Press the S for about 1 second, and return to the auxiliary function panel to display " Fn001 ".

Table 8-2 Rigidity level comparison table(Pn10B.1=0 PI control)

level (Rigidity level)	pn100 (Speed gain)	pn101 (Speed integration)	pn102 (Position gain)	pn401 (Torque filtering)
1	100	4500	140	300
2	200	3000	286	198
3	300	2500	428	148
4	400	2000	571	99
5	500	1666	714	82
6	600	1333	857	66

7	700	1166	1000	58
8	800	1000	1143	49
9	900	900	1286	44
10	1000	800	1429	39
11	1100	733	1571	36
12	1200	667	1714	33
13	1300	619	1857	30
14	1400	571	2000	28
15	1500	535	2143	26
16	1600	500	2286	24
17	1700	472	2428	23
18	1800	444	2571	22
19	1900	422	2714	20
20	2000	400	2857	19
21	2100	383	2940	18
22	2200	366	3080	17
23	2300	353	3220	16
24	2400	340	3370	15
25	2500	330	3500	14
26	2600	320	3650	13
27	2700	312	3800	12
28	2800	304	3930	11
29	2900	297	4118	10
30	3000	290	4250	9

Table 8-3 Rigidity level comparison table(Pn10B.1=1 I-P control)

level (Rigidity level)	pn100 (Speed gain)	pn101 (Speed integration)	pn102 (Position gain)	pn401 (Torque filtering)
1	100	2000	100	300
2	200	1400	200	200
3	300	900	300	130
4	400	700	400	100
5	500	500	500	80
6	600	450	600	70
7	700	400	700	60
8	800	350	800	50
9	900	320	900	45
10	1000	300	1000	40
11	1100	270	1100	32
12	1200	250	1200	35
13	1300	230	1300	32
14	1400	200	1400	30
15	1500	200	1500	27
16	1600	200	1600	25
17	1700	180	1700	22
18	1800	170	1800	20
19	1900	165	1900	17
20	2000	160	2000	15
21	2000	160	2000	15
22	2000	160	2000	15

23	2000	160	2000	15
24	2000	160	2000	15
25	2000	160	2000	15
26	2000	160	2000	15
27	2000	160	2000	15
28	2000	160	2000	15
29	2000	160	2000	15
30	2000	160	2000	15

8.4 JOG (Fn002)

JOG operation refers to the function to confirm the servo motor operation through speed control without connecting to the host device.

(1) Setting items before operation

To perform JOG operation, make the following settings in advance.

- **When the S-ON input signal is ON, please switch it to OFF.**
- **input signal parameter is set to "S-ON force valid" (always-ON " valid "), please change it to a value other than " Force valid ".**

Table 8-4 Parameters for Jog (JOG) speed

Pn304	Jogging speed	Speed / Position / Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0 ~ 10000	1 rpm	500		

- **Please set the JOG operation speed after considering the operation range of the machine used. JOG running speed is set by Pn304.**

(2) Operation steps

The following describes the operation steps when the servo motor rotation direction is set to Pn000.0=0 (CCW is forward-rotation). Acceleration and deceleration in the process of FN002 is subject to Pn 305 and Pn 306. For the usage of these two parameters, please refer to " Section 6.9 Soft starting".

JOG operation are as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ⋀ or ⋁ to display "Fn002",

③ Press the S to display " -JOG",

④ Press the M key to display " --JOG" to enter into servo-ON.

⑤ Press the ⋀ key (forward-rotation) to ⋁ key (reversed-rotation) and the servo motor rotates at the speed set by Pn304.

⑥ Press the M key to enter into the servo-OFF. You can also press S for about 1 sec to turn off the servo.

⑦ Press the S key for about 1 sec, then return to "Fn002".

8.5 Origin search (Fn003)

Origin search is a function to determine the position of the origin pulse (phase C) of the incremental encoder and stop at that position. This function is used when the motor shaft and mechanical position need to be positioned.

Origin search can be performed under the following conditions.

• S-ON is not input.

The servo motor speed 60rpm.

Points	• Please execute the origin search when the coupling is not connected. • Forward-rotation drive prohibition (P-OT) and reverse-rotation drive prohibition (N-OT) are invalid when performing origin search,

The operation steps of origin search and positioning are as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ▲ or ▼ key to display "Fn003",

③ Press the S for 1 sec, Fn003 (origin search)" - .CSR" is displayed for about 1 sec.

④ Press the M key to enable the servo and then long-press ▲ (forward-rotation) or ▼ (reverse-rotation) to origin search, then search direction changes according to the setting of Pn000.0. Then long-press ▲ (forward-rotation) or ▼ (reverse-rotation) until the servo motor stops, and the " .CSR "flashes on the panel, at this moment, the origin search is completed.

⑤ After the origin search is completed, press M key to disable the servo motor, and the panel displays " - .CSR".

⑥ Press the S for 1 sec and return to the auxiliary function mode "Fn003"(origin serach) .

8.6 JOG program (Fn004)

JOG program refers to the function of setting and executing the continuous operation determined by the preset operation mode, moving distance, moving speed, acceleration and deceleration time, and the number of repeated operations.

This function is the same as JOG operation (Fn002) and no need to connecte the upper device. Confirm the servo motor's operation and have the simple positioning.

(1) Setting items before operation

To perform Program JOG operation, make the following settings in advance.

• Please consider the operating range and safe operating speed of the machine, and set the correct operating distance and operating speed.

• Please make the servo drive ready.

• Switch the S-ON input signal to OFF.

<Supplement>

• Position command filtering, in position control, can be performed.

• The Overtravel prevention function becomes valid.

(2) Related parameters

The parameters that can be set in the program JOG operation are as follows.

Table 8-5 Parameters for Program JOG operation setting

Pn530	Program Jogging-related selections		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0000 ~ 0005H	-	0000		

<table>
<tr><td rowspan="3">Pn531</td><td colspan="3">Program Jogging travel distance   Speed Position Torque</td><td>When enabled</td><td>Classification</td></tr>
<tr><td>Setting range</td><td>Unit</td><td>Default value</td><td rowspan="2">Immediately</td><td rowspan="2">Setup</td></tr>
<tr><td>1 ~ 1073741824 (2^{30})</td><td>1 instruction unit</td><td>32768</td></tr>
<tr><td rowspan="3">Pn533</td><td colspan="3">Program jogging travel speed   Speed Position Torque</td><td>When enabled</td><td>Classification</td></tr>
<tr><td>Setting range</td><td>Unit</td><td>Default value</td><td rowspan="2">Immediately</td><td rowspan="2">Setup</td></tr>
<tr><td>1 ~ 10000</td><td>1 rpm</td><td>500</td></tr>
<tr><td rowspan="3">Pn534</td><td colspan="3">Program jogging acceleration/ deceleration time   Speed Position Torque</td><td>When enabled</td><td>Classification</td></tr>
<tr><td>Setting range</td><td>Unit</td><td>Default value</td><td rowspan="2">Immediately</td><td rowspan="2">Setup</td></tr>
<tr><td>2 ~ 10000</td><td>1 ms</td><td>100</td></tr>
<tr><td rowspan="3">Pn535</td><td colspan="3">Program jogging waiting time   Speed Position Torque</td><td>When enabled</td><td>Classification</td></tr>
<tr><td>Setting range</td><td>Unit</td><td>Default value</td><td rowspan="2">Immediately</td><td rowspan="2">Setup</td></tr>
<tr><td>0 ~ 10000</td><td>1 ms</td><td>100</td></tr>
<tr><td rowspan="3">Pn536</td><td colspan="3">Program jogging travel count   Speed Position Torque</td><td>When enabled</td><td>Classification</td></tr>
<tr><td>Setting range</td><td>Unit</td><td>Default value</td><td rowspan="2">Immediately</td><td rowspan="2">Setup</td></tr>
<tr><td>0 ~ 1000</td><td>1</td><td>1</td></tr>
</table>

Table 8-6 Pn530 parameters setting

<table>
<tr><th colspan="2">Parameter</th><th>Meaning</th><th>Default value</th></tr>
<tr><td rowspan="6">Pn530</td><td>n. □□□ 0</td><td>(Waiting time Pn535 → Forward travel distance Pn531) × Number of movements Pn536</td><td rowspan="6">0</td></tr>
<tr><td>n. □□□ 1</td><td>(Waiting time Pn535 → Reverse travel distance Pn531) × Number of movements Pn536</td></tr>
<tr><td>n. □□□ 2</td><td>(Waiting time Pn535 → Forward travel distance Pn531) × Number of movements Pn536
(Waiting time Pn535 → Reverse travel distance Pn531) × Number of movements Pn536</td></tr>
<tr><td>n. □□□ 3</td><td>(Waiting time Pn535 → Forward travel distance Pn531) × Number of movements Pn536
(Waiting time Pn535 → Reverse travel distance Pn531) × Number of movements Pn536</td></tr>
<tr><td>n. □□□ 4</td><td>(Waiting time Pn535 → Forward travel distance Pn531 → Waiting time Pn535 → Reverse travel distance Pn531)× Number of movements Pn536</td></tr>
<tr><td>n. □□□ 5</td><td>(Waiting time Pn535 → Forward travel distance Pn531 → Waiting time Pn535 → Forward travel distance Pn531)× Number of movements Pn536</td></tr>
</table>

(3) How to set unlimited operation

• When Pn530.0=0/1/4/5, set the Number of movements (Pn536) to " 0 " to run infinitely.

• The program JOG operation mode follows the setting of Pn530.0. In various operating modes, when Pn536≠0, the maximum number of movements is 1000 times. Please refer to Table 8-3 and Table 8-4 for details.

(4) Operation steps

The operation steps of Program JOG operation are as follows:

① Press the (M) key to switch to auxiliary function mode " Fn000 ".

② Press the (∧) or (∨) key to display " Fn004 ",

③ Press the (S) key for about 1 sec or more.

④ Press the (M) key to enter into servo-ON.

⑤ In accordance with the initial movement direction of the operation mode (∧) or (∨) key, it will start to act after the waiting time.

⑥ If the JOG operation of program finished, "End" will flash and then return to the Step 4.

8.7 Initialize parameters (Fn005)

Points	• Parameter setting value initialization must be done with the servo OFF. It cannot be executed while the servo is ON. • Restart the power supply to make the setting effective.

Function used to restore parameters to default settings.

The parameter setting initialization operation steps are as follows:

① Press the (M) key to switch to auxiliary function mode "Fn000".

② Press the (∧) or (∨) key to display "Fn005".

③ Press the (S) key for more than 1 second and display "P.INIT".

④ Press the (M) key to start parameter initialization. During initialization, the display will blink.

⑤ After initialization is complete, "donE" will blink for about 1 second.

⑥ After displaying "donE", return to displaying "P.INIT".

⑦ Press the (S) key, return "Fn005" is displayed.

⑧ To make the setting effective, please turn on the power of the servo drive again.

8.8 Clear alarm history (Fn006)

Function to delete all alarm records recorded in the servo drive.

Alarm records can only be deleted by this function. Even if the alarm is reset or the main circuit power supply of the servo drive is cut off, the alarm history cannot be deleted.

The operation steps to delete the alarm records are as follows:

① Press the (M) key to switch to auxiliary function mode "Fn000".

② Press the (∧) or (∨) key to display "Fn006".

③ Press the (S) key for more than 1 second , the display shows "TRCLR".

④ Press the (M) key to clear the alarm history. after clearing"donE" will blink for about 1 second.

⑤ "donE" is displayed.

⑥ Press the (S) key to return to "Fn006".

8.9 Setting (Initialization) of the absolute encoder and encoder alarm reset (Fn008)

DANGER

・After the setting of the absolute encoder, the rotation amount of data will be within the range of -2 revolutions to +2 revolutions. Since the reference position of the mechanical system will change, please determine the reference position of the upper device according to the position after the setting.

・If the machine is operated without positioning the host device, unexpected mechanical movements may occur, resulting in personal accidents or mechanical damage. Please operate the machine with caution.

The absolute encoder must be initialized and set in the following situations:

When the system is put into use for the first time.

When the "Encoder Backup Alarm (A.810)" occurs.

When the "Encoder Checksum Alarm (A.820)" occurs.

When the serial data of the rotation amount of the absolute encoder needs to be initialized.

Perform the basic initialization setting through Fn008.

① Please the M on the panel to select the auxiliary function Fn000, and the panel will display "Fn000".

② Press the ⋀ or ⋁ , and the panel will display "Fn008".

③ Press the S for about 1 second, and the panel will display "PGCL1".

④ Press the ⋀ until the panel displays "PGCL5". (If a wrong key operation is performed halfway, the panel will display "no_oP" and flash for about 1 second, and then return to the auxiliary function execution mode. At this time, please start the operation again from the beginning.)

⑤ Press the M to start the initialization setting of the absolute encoder. After the setting is completed, the panel will display "donE" and flash for about 1 second.

⑥ Return to the panel display "PGCL5".

⑦ To make the setting effective, please turn on the power again.

8.10 Auto tuning motor current detection signal offset (Fn00E)

Points

・The automatic adjustment of the offset value of the motor current detection signal must be operated at servo OFF.

・When the torque fluctuation is significantly larger than other servo drives, perform automatic adjustment of the offset.

This function is only used when higher precision adjustment is required to further reduce torque ripple. Generally no adjustments are required.

The operation steps of the automatic adjustment of the offset value of the motor current detection signal are as follows:

① Press the M key to switch to auxiliary function mode "Fn000".

② Press the ⋀ or ⋁ key to display "Fn00E".

③ Press the S key for more than 1 sec , and "CuR_o".

④ Press the M key to clear the alarm history. after clearing" donE" will blink for about 1 second.

⑤ "donE" display and returned.

⑥ Press the S key, and return to "Fn00E".

8.11 Manually adjust motor current detection signal offset (Fn00F)

Points	
! Points	When performing manual adjustment, if this function executed by mistake, the characteristics may be dreduced. When performing manual adjustments, follow the precautions below. • Make the servo motor rotate at about 100 rpm, • Observe the torque command monitoring in the analog monitoring state, and reduce the fluctuation.

This function is only used when higher precision adjustment is required to further reduce torque ripple. Generally no adjustment is required.

The operation steps of manual adjustment of the offset value of the motor current detection signal are as follows:

① Press the (M) key to switch to auxiliary function mode " Fn000 ".

② Press the (∧) or (∨) key to display "Fn00F".

③ To adjust the U-phase offset, press (S) key for about 1 sec , and " Cu1_o" displayed.

④ Press the (S) key (less than 1 sec), and display U-phase offset.

⑤ Press the (∧) key or (∨) key to change the offset. The torque command must also be carefully adjusted while observing the monitor signal.

⑥ Press the (S) key (less than 1 sec) to confirm U-phase current offset adjustment.

⑦ Adjust the offset of V- phase. Press (S) key for about 1 sec , and " Cu2_o"display.

⑧ Press the (S) key (less than 1 sec), to display the offset value of V- phase.

⑨ Press the (∧) or (∨) key to change the offset. The torque command must also be carefully adjusted while observing the monitor signal.

⑩ Press the (S) key (less than 1 sec), and "Cu2_o" is displayed, to confirm the W-phase current offset adjustment.

⑪ Press the (S) key for about 1 sec , and "Fn00F" is displayed.

8.12 Writing prohibition setting (Fn010)

Function to prevent accidental writing of parameters.

(1) Operation steps

Table 8-7 Parameter setting

Parameter value	Functional operation
0000	Writing permission (write prohibition disabled)
0001	Write prohibition (parameters cannot be written after turning on the power next time)

The operation steps of the automatic adjustment of the offset value of the motor current detection signal are as follows:

① Press the (M) key to switch to auxiliary function mode " Fn000 ".

② Press the (∧) or (∨) key to display " Fn010".

③ Press the (S) key for about 1 sec or more.

④ Press the (∧) or (∨) key, and set it to any of the following values. Refer to Table 8-6 .

⑤ " donE" display and return to " P000_".

⑥ Press the (S) key for about a sec , and return to " Fn010 ".

⑦ To make the setting effective, please restart the power of the servo drive.

Note: This function of FN010 cannot be realized in the debugging software now.

---

(2) Related parameters

All Pn □□□ and auxiliary functions (Fn □□□) listed in " Table 8-9 Auxiliary function list of writing prohibition setting " can be set as write-prohibited or write-permitted.

Table 8-8 Auxiliary function list of writing prohibition setting

Fn No.	Function	Operation by operation	By HCServoWorks HCServoWorks.
Fn001	Simple rigidity selection	1	1
Fn002	JOG	1	1
Fn003	Origin search	1	1
Fn004	Jog program	1	1
Fn005	Initialize parameters	1	1
Fn006	Clear alarm history	1	1
Fn008	Setting (initialization) of the absolute encoder and encoder alarm reset	1	1
Fn00E	Auto tuning motor current detection signal offset	1	1
Fn00F	Manually adjust motor current detection signal offset	1	1
Fn01B	Initialize vibration detection level	0	1
Fn080	Magnetic pole detection	1	1
Fn082	Current JOG	1	1
Fn200	Tuning-less level setting	1	1
Fn201	Advanced auto tuning	1	1
Fn202	Advanced auto tuning with command	0	1
Fn203	One-parameter tuning	1	1
Fn204	Adjust anti-resonance control	0	1
Fn205	MFC vibration detection	0	1
Fn206	EasyFFT	1	1
Fn207	Auto vibration detection	0	1

Note: When the Writing Prohibition Setting (Fn010) is valid, if the above auxiliary functions are executed, the display on the panel operator is as follows, and the corresponding operations cannot be performed. To perform these auxiliary functions, the Fn010 must be changed to disabled, and "no oP" will be displayed on the panel, flashing for 1 second.

8.13 Display servomotor model (Fn011)

This function displays the model, voltage, capacity, encoder type, and encoder resolution of the servo motor connected to the servo unit. If the servo unit is a special specification product, the special specification number will also be displayed.

The operation steps are as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ∧ or ∨ key to display " Fn011 ".

③ Press and hold the S key for about 1 second. The servo motor model and voltage identification data will be displayed, for example," F0132 " , where 01 indicates a 220V motor, 3 indicates high inertia, and 2 indicates an X6 motor.

④ Press the M key to display the servo motor capacity. For example, " P0040 " indicates 400W.

⑤ Press the M key to display the encoder type and resolution. For example," E0023 "ndicates an incremental 23-bit encoder, and " E0123 " indicates an absolute 23-bit encoder.

⑥ Press the M key to display the special specification number of the servo unit. " Y0000 " indicates a standard product.

⑦ Press and hold the S key for about 1 second to return to the " Fn011 " display.

8.14 Display software version (Fn012)

① Press the (M) key to switch to auxiliary function mode " Fn000 ".

② Press the (∧) or (∨) key to display " Fn012 ".

③ Press and hold the (S) key for about 1 second to display the host firmware version, e.g., “r.5311”.

④ Press the (M) key to display the host firmware sub-version, e.g., “t.0b00”.

⑤ Press the (M) key to display the Ecat ESC version, e.g., “E.0008”.

⑥ Press the (M) key to display the boot version of the servo unit, e.g., “b.4C12”.

⑦ Press the (M) key to display the slave version of the servo unit, e.g., “C.0724”.

⑧ Press the (M) key to display the Ecat Xml version, e.g., “L.0000”.

⑨ Press the (M) key to display the Ecat Xml version, e.g., “P.5428”.

⑩ Press the (S) key to return to the " Fn012 " display.

8.15 Initialize vibration detection Level (Fn01B)

This function is to automatically set the Vibration Detection Level (Pn312) in order to detect the "Vibration Alarm (A.520)" and "Vibration Warning (A.911)" more accurately after detecting the mechanical vibration in the running state.

The vibration detection function can detect the vibration component at a certain speed of the servo motor. When the vibration exceeds the detection value calculated by the following detection formula , an alarm or warning will be displayed through the Vibration Detection Selection (Pn310).

Detection value=Vibration detection

Detection value=Vibration detection value（Pn312[rpm]）×Detection sensitivity（Pn311 [%]）/100

<Remarks>

• This function can only be set when the vibration is detected by the factory-set Vibration Detection Level (Pn312) and the "Vibration Alarm (A.520)" or "Vibration Warning (A.911)" is not displayed at the correct time .

• Depending on the state of the machine used, the detection sensitivity of vibration alarms and warnings may vary. In this case, fine-tune the Vibration Detection Sensitivity (Pn311) by referring to the detection formula above.

Points	
Points	• If the servo gain is not set properly, it may be difficult to detect vibration. And it may not be possible to detect all vibrations. • Please set an appropriate Moment of Inertia Ratio (Pn103). If the settings are not correct, vibration alarms and vibration warnings may be falsely detected or may not be detected. • To set this function, the customer must have the operation with the actual command. • Execute after changing to the operating state where the vibration detection value is to be set. If the setting is made while the servo motor is rotating at low speed, vibration will be detected immediately after the servo is turned ON. If it is set when the servo motor is running at a speed less than 10% of the maximum speed, "Error" will be displayed.

(1) Steps

The operation steps of the automatic adjustment of the motor current detection offset are as follows:

① Press the (M) key to switch to auxiliary function mode " Fn000 ".

② Press the ⌃ or ⌄ key to display "Fn018".

③ Press the S key for about 1 sec , and "d.INIT" displayed .

④ Press the M key, then "d.INIT" flashes, it will detect and update the vibration value. The detection and update will continue until the MODE/SET key is pressed again.

⑤ Press the M again at the appropriate time to finish the detection and updates. "donE" displays after the setting is completed normally. "Error"will display when the setting cannot be completed normally.

⑥ Press the S key to return to "Fn018".

(2) Related parameters

The relevant parameters are as follows:

Table 8-9 Parameters for vibration detection initialization

Pn311	Vibration detection sensitivity	Speed Position Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	50 ~ 500	1%	100		
Pn312	Vibration detection level	Speed Position Torque		When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0 ~ 5000	1 rpm	50		

Note: Pn312 is set by the detection value of vibration detection, so adjustment is not required. The detection sensitivity is set by Pn311.

Table 8-10 Pn310 Parameter setting

Parameter		Meaning	When enabled	Classification
Pn310	n. □□□ 0	Do not detect vibration (Default value)	Immediately	Setup
	n. □□□ 1	A warning occur after vibration is detected (A.911).	Immediately	Setup
	n. □□□ 2	A warning occur after vibration is detected (A. 520).		

8.16 Software reset (Fn030)

This function resets the servo drive internally by software. Sometimes it is necessary to restart the power supply after changing the parameter setting. Using this function can make the setting effective without restarting the power supply.

Points	
! Points	• This function must be operated at servo OFF. • This function has nothing to do with the upper device and can reset the servo drive. Be sure to disconnect with the upper device.

The operation steps of software reset are as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ⌃ or ⌄ key to display " Fn030 ".

③ Press the S key for about 1 sec to display "SrStI ".

④ Press the ⌃ key until "SrStS" displayed.

⑤ Press the M key, the panel display disappears.

8.17 Magnetic pole detection (Fn080)

The operation steps of magnetic pole detection are as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ∧ or ∨ key to display "Fn080".

③ Press the S key for about 1 sec to display "L0040".

④ Press the M to display "=PdEt".

⑤ Press the M key, the panel display "-PdEt", start magnetic pole detection.

⑥ Jump to "Fn080" after detection is completed.

8.18 Current JOG (Fn082)

Jog operation is a function that allows the servo motor to be operated using torque control without connecting a host device.

(1) Preset items before operation

To perform jog operation, the following settings must be made in advance:

- When the S-ON input signal is ON, switch it to OFF.
- If Pn50A.1 is set to "7" (Always servo ON "enabled"), change it to a value other than "7".

(2) Operation steps

The operation steps for current jog operation are as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ∧ or ∨ key to display " Fn082 ".

③ Press and hold the S key for about 1 second to display " T.000 ".

④ Press the ∧ or ∨ key to adjust the torque command value.

⑤ Press and hold the S key for about 1 second to display " R.000 ".

⑥ Press the ∧ or ∨ key to adjust the electrical angle.

⑦ Press and hold the S key for about 1 second to display " StoP.0 ".

⑧ Press the M key to enter current jog. " CJOG0 " is displayed.

- When the electrical angle is < 360° , the current loop electrical angle is set to the adjusted value. Press the ∧ or ∨ key to output forward/reverse torque command. The motor holds its angle.

- When the electrical angle is ≥ 360° , the current loop electrical angle value is determined by the encoder. Press the ∧ or ∨ key to rotate the motor forward or reverse.

⑨ Press the M key to exit current jog. " StoP.0 " is displayed.

⑩ Press the S key to return to the " Fn082 " display.

8.19 Tuning-less level setting (Fn200)

Operation steps using the panel operator:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ∧ or ∨ key to select " Fn200 ".

③ Press and hold the S key for 1 second to switch to the tuning-less load value setting screen " d 1 ".

④ Press the M key to switch to the tuning-less rigidity value setting screen " L 4 ".

⑤ Press the ∧ or ∨ key to select the rigidity value. The higher the number, the higher the gain and the higher the responsiveness. (Default value : 4)

- **If the rigidity value is too high, vibration may occur. In this case, reduce the rigidity value.**
- **If high-frequency noise occurs, press the S key to automatically adjust the notch filter frequency to the vibration frequency.**

⑥ Press the M key. The status display will change to " dOnE " and flash for about 1 second, then display " L0004 ". The setting is saved in the servo unit.

⑦ Press and hold the S key for about 1 second to return to the " Fn200 " display.

Note: If overshoot occurs in the response waveform, or if the equipment is used under a load exceeding the permissible load moment of inertia (outside the product warranty), press the key to set the load value to "2".

8.20 Advanced auto tuning 1 (Fn201)

The operation steps for Advanced Automatic Tuning 1 (Fn201) are as follows:

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ∧ or ∨ to display " Fn201 ".

③ Press the S for about 1 second to enter the pre-start configuration stage and make adjustments according to actual needs.

(1) It shows " J. On ". At this time, the inertia self - tuning is checked. If it needs to be unchecked, press the ∧ and it will show " J. OFF ".

(2) Press the M , it shows " 0030 ". This is for tuning the moving distance, with the unit of turns. Use the ∧ or ∨ to change the moving distance.

(3) Press the M , it shows " L 2 ". Select the tuning mode [*1]. Use the ∧ or ∨ to change the mode.

(4) Press the M , it shows " t 2 ". Select the mechanical structure [*2]. Use the ∧ or ∨ to change the mode.

(5) Press the M , it shows " GAIn.2 ". Set the initial gain level for automatic tuning. Use the ∧ or ∨ to change the value.

(6) Press the M , it shows " JrAt.2 ". Set the initial estimated inertia for automatic tuning. Use the ∧ or ∨ to change the value.

(7) Press the M , it shows " COIn.4 ". Set the initial positioning accuracy for automatic tuning. Use the ∧ or ∨ to change the value.

(8) Press the M , it shows " G.0070 ". Set the gain saving ratio. Use the ∧ or ∨ to change the value, and use the S to shift.

(9) Press the M , it shows " Auto ". The automation process is enabled by default. Press the ∧ to change the setting, and it shows " hAnd " to turn off the automation process.

④ Press the S for about 1 second to start the tuning, and the following relevant key operations will be automatically executed. If users need to perform key operations manually, set it to " hAnd " in ③ .(9) to turn off the automation process.

⑤ It shows " SET- ", and the tuning process starts.

⑥ Press the (《) to enable the servo, and it shows "SET-¯" or "SET-_".

⑦ Press the (∧) or (∨) to show " J.1000", and enter the inertia self-estimation stage. The displayed value flashes. After the estimation is completed, the displayed value stops flashing.

⑧ Press the (∧) or (∨) again to show "G.runS", and the gain search starts.

⑨ After the gain search is completed without errors, it shows "End".

⑩ Press the (S) , it shows "donE". Save the tuning results and automatically exit the advanced automatic tuning. It shows "Fn201".

Note:

1. For the details of *1 tuning mode, please refer to 7.3 Advanced automatic tuning table 7-14 Explanation table of tuning modes.

2. For the details of *2 mechanical structure, please refer to 7.3 Advanced automatic tuning table 7-15 Explanation table of mechanism selection.

3. If any error occurs during the tuning process, "Error" will be displayed, and then it will automatically exit the advanced automatic tuning and display the warning code, such as ".9C3". For details, please refer to 7.3.2 "Tuning alarm number correspondence table".

8.21 Advanced auto tuning 2 (Fn202)

The operation steps for Advanced Automatic Tuning 2 (Fn202) are as follows:

① Press the (M) key to switch to auxiliary function mode " Fn000 ".

② Press the (∧) or (∨) to display "Fn202".

③ Press the (S) for about 1 second to enter the pre-start configuration stage and make adjustments according to actual needs.

(1) It shows "J. On". At this time, the inertia self - tuning is checked.

If it needs to be unchecked, press the (∧) and it will show " J. OFF ".

(2) Press the (M) , it shows "L 2". Select the tuning mode *1. Use the (∧) or (∨) to change the mode.

(3) Press the (M) , it shows "t 2". Select the mechanical structure *2. Use the (∧) or (∨) to change the mode.

(4) Press the (M) , it shows " GAIn.2". Set the initial gain level for automatic tuning. Use the (∧) or (∨) to change the mode.

(5) Press the (M) , it shows " JrAt.2". Set the initial estimated inertia for automatic tuning. Use the (∧) or (∨) to change the mode.

(6) Press the (M) , it shows "COIn.4". Set the initial positioning accuracy for automatic tuning. Use the (∧) or (∨) to change the mode.

(7) Press the (M) , it shows "G.0070". Set the gain saving ratio. Use the (∧) or (∨) to change the value, and use the (S) to shift.

(8) Press the (M) , it shows " Auto". The automation process is enabled by default. Press the (∧) to change the setting,

and it shows " hAnd " to turn off the automation process.

④ Press the (S) for about 1 second to start the tuning, and the following relevant key operations will be automatically executed.

If users need to perform key operations manually, set it to " hAnd " in ③ .(8) to turn off the automation process.

⑤ It shows " SET-", and the tuning process starts.

⑥ Control servo enable from the host unit, and it shows " SET-_ " or " SET-¯ ".

⑦ Press the ⌃ or ⌄ to show " J.1000 ", and enter the inertia self-estimation stage. The displayed value flashes.

After the estimation is completed, the displayed value stops flashing and show " G.runS ". Input a position command from the host unit (it is recommended that the interval time between position commands be at least 300 ms), and then start the gain search.

⑧ After the gain search is completed without errors, it shows " End ".

⑨ Press the S , it shows " donE ". Save the tuning results and automatically exit the advanced automatic tuning. It shows " Fn202 ".

Note:

1. The *2 and *3 modes are the same as those in 8.17 Advanced Automatic Tuning 1 (Fn201).

2. For *1 and *4, when the servo controlled by the host computer unit is already in the running state, it can directly enter or exit the Advanced Automatic Tuning of Fn202. When the motor is running, "WAIT" will be displayed, and it will disappear only when the motor is in a stationary state (it is recommended that the interval time between position commands be at least 300 ms).

3. If any error occurs during the tuning process, "Error" will be displayed, and then it will automatically exit the advanced automatic tuning and display the warning code, such as ".9C3". For details, please refer to 7.4.2 "Tuning alarm number correspondence table".

8.22 One-parameter tuning (Fn203)

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ⌃ or ⌄ key to display " Fn203 ".

③ Press and hold the S key for about 1 second to display " A.d 0 ".

④ Press the ⌃ key to display " A.d 1 ".

⑤ Press the S key (for less than 1 second) to display " L0042 ".

⑥ Press the ⌃ or ⌄ key to change the value. Press the M key. " donE " will be displayed and flash three times, then " L0042 " remains displayed.

8.23 EasyFFT (Fn206)

After vibration occurs, setting a notch filter according to the vibration frequency can sometimes be effective in suppressing vibration. This function utilizes the mechanical characteristics to detect and set the frequency of the notch filter and then sets this frequency as a parameter. This setting function is called EasyFFT.

EasyFFT transmits the periodic waveform command from the servo unit to the servo motor, causing the servo motor to rotate slightly several times within a certain period of time to make the machinery vibrate. The servo unit detects the resonance frequency based on the vibration generated by the machinery and then sets the corresponding notch filter according to this resonance frequency. The notch filter can effectively eliminate high-frequency vibrations and noises.

① Press the M key to switch to auxiliary function mode " Fn000 ".

② Press the ⌃ or ⌄ to display " Fn206 ".

③ Press the S for more than about 1 second, and it will display " InIS " (Here, use the up and down keys to modify the vibration amplitude during the test, and keep it as the default without making any changes).

④ Press the S for more than about 1 second, and it will display " F. ".

⑤ Press the M (less than 1 second), and it will display " . .run ".

⑥ Press the ▲ or ▼, and the motor will run at a very small angle and make a sound. At the same time, "E_FFT" will flash three times.

⑦ After completion, it will display "F.XXXX" (XXXX is the first segment notch filter frequency detected in the current test). If multiple tests need to be performed, stay on this interface and press the ▲ or ▼ again.

After the test is completed, if this frequency needs to be written, press the M, and it will display "donE", and after flashing three times, it will still display "..run".

⑧ Press the ▲ or ▼. Similar to the first segment test process, after displaying "F.XXXX", press the M again to write the second segment frequency.

⑨ When writing the first segment, PN408.0 will be changed to 1, that is, the function of the first segment is turned on, and at the same time, PN409 will be written (similarly for the second segment, change PN408.2 to 1, and write PN40C at the same time). after both segments are written, long press the M to exit the FN206 function.

⑩ fter detecting the frequency, if the S is not pressed, the corresponding frequency will not be written.

Chapter 9 Monitoring Display

9.1 Monitoring display list

Monitoring display is to display the command value, the status of input and output signals, and the internal status of the servo drive. The monitoring display list is as follows.

Table 9-1 Monitoring display list

Un No.	Display content	Unit	Display description
Un000	Motor speed	rpm	16-bit decimal display
Un001	Speed command	rpm	16-bit decimal display
Un002	Torque command (Related to rated torque)	%	16-bit decimal display
Un003*3	Rotation angle 1	Number of pulses from origin	32-bit decimal display
Un004	Rotation angle 2 (Angle from origin (Electrical angle))	deg	16-bit decimal display
Un005*1	Input signal monitoring	—	32-bit binary display
Un006*2	Output signal monitoring	—	32-bit binary display
Un007	Input command pulse speed (Valid only for position control)	rpm	16-bit decimal display
Un008	Deviation counter (Position deviation) (Valid only for position control)	Command unit	32-bit decimal display
Un009	Accumulated load ratio (100% rated torque: Display effective torque in 10s cycle)	%	16-bit decimal display
Un00A	Regenerative load ratio (100% handleable regenerative power%: Display regenerative power consumption in 10s cycle)	%	16-bit decimal display
Un00B	Power consumed by DB resistance (100% handleable power with the dynamic brake: DB power consumption in 10s cycle)	%	16-bit decimal display
Un00C	Input command pulse counter (32-bit decimal display)	Command unit	32-bit decimal display
Un00D	Feedback pulse counter (Incremental data of 4 times of the number of encoder pulses: 32- bit decimal display)	Encoder pulse	32-bit decimal display
Un00E	Fully-closed loop feedback pulse counter (Incremental data of 4 times of the number of fully-closed loop feedback pulse : 32-bit decimal display)	External encoder pulse	32-bit decimal display
Un00F	Fully-closed feedback speed	pulse/s	32-bit decimal display
Un012	Total operation time	100 ms	32-bit decimal display
Un013*3	Feedback pulse counter	Command unit	32-bit decimal display
Un014	Effective gain monitor	—	16-bit decimal display
Un032	Instantaneous power consumption	[W]	16-bit decimal display
Un033	Power consumption	[Wh]	32-bit decimal display
Un034	Cumulative power consumption (integer part)	[Wh]	32-bit decimal display
Un039	Cumulative power consumption (fractional part)	[0.001Wh]	32-bit decimal display
Un040	Absolute encoder multiturn value	rev	32-bit decimal display
Un041	Absolute encoder single-turn value	Pulse	32-bit decimal display
Un042	Absolute encoder position data (lower word)	Pulse	32-bit decimal display
Un043	Absolute encoder position data (upper word)	Pulse	32-bit decimal display
Un027	Built-in fan life monitor	0.01%	16-bit decimal display
Un028	Capacitor life monitor	0.01%	16-bit decimal display
Un029	Soft-start circuit life monitor	0.01%	16-bit decimal display
Un02A	DB circuit life monitor	0.01%	16-bit decimal display
Un02B	Soft-start relay operation count	Count	32-bit decimal display
Un02C	DB relay operation count	Count	32-bit decimal display
Un058	Coulomb friction identification status	—	16-bit decimal display
Un059	Coulomb friction identification fitness	—	32-bit decimal display
Un060	ESC application layer status	—	16-bit decimal display
Un061	PDI error counter (soft)	—	16-bit decimal display
Un062	Invalid frame counter of port 0	—	16-bit decimal display

Un063	Receive error counter of port 0	—	16-bit decimal display
Un064	Invalid frame counter of port 1	—	16-bit decimal display
Un065	Receive error counter of port 1	—	16-bit decimal display
Un066	Forwarding error counter of port 0	—	16-bit decimal display
Un067	Forwarding error counter of port 1	—	16-bit decimal display
Un068	Program unit error counter	—	16-bit decimal display
Un069	PDI error counter (hw)	—	16-bit decimal display
Un070	PDI error code	—	16-bit decimal display
Un071	PDI/MC interface error code	—	16-bit decimal display
Un072	Port 0 link loss counter	—	16-bit decimal display
Un073	Port 1 link loss counter	—	16-bit decimal display
Un094	Advanced auto-tuning feedback	—	16-bit hexadecimal display
Un107	Residual vibration frequency	0.1Hz	16-bit decimal display
Un10A	Heatsink temperature monitor	℃	16-bit decimal display
Un10D	Control board temperature monitor	℃	16-bit decimal display
Un10F	Encoder internal temperature	℃	16-bit decimal display
Un110	Internal signal monitoring	—	32-bit binary display
Un120	Internal input signal monitoring	—	32-bit binary display
Un130	Internal output signal monitoring	—	32-bit binary display
Un134	Adaptive notch filter (Pn466) sweep frequency	Hz	32-bit decimal display
Un138	Online inertia value	%	16-bit decimal display
Un140	Main circuit bus voltage	V	16-bit decimal display
Un141	Current detection value	%	16-bit decimal display
Un142	Cumulative load rate	% (cycle 2ms)	16-bit decimal display
Un143	Regenerative load rate	% (cycle 20s)	16-bit decimal display
Un144	DB resistor power consumption	% (cycle 2ms)	16-bit decimal display
Un145	Maximum cumulative load rate	% (cycle 10s)	16-bit decimal display
Un146	Moment of inertia ratio / weight ratio	%	16-bit decimal display
Un148	T-REF monitor	%	16-bit decimal display
Un149	V-REF monitor	rpm, mm/s	16-bit decimal display
Un14A	Input command pulse frequency	pps	32-bit decimal display
Un171	Control board temperature	0.1℃	16-bit decimal display
Un172	Power board temperature	0.1℃	16-bit decimal display
Un203	Abnormal parameter number setting (A.040)	—	16-bit hexadecimal display
UnC1B	U-phase current AD value	—	16-bit decimal display
UnC1C	V-phase current AD value	—	16-bit decimal display
UnC1D	Motor mechanical angle	deg	16-bit decimal display
UnC1E	Current loop status	—	16-bit decimal display
UnC1F	Current loop control configuration	—	16-bit decimal display
UnC20	Current number of program jog runs	Count	16-bit decimal display
UnC21	Torque input P terminal AD	—	16-bit decimal display
UnC22	Torque input N terminal AD	—	16-bit decimal display
UnC23	Serial encoder disconnection count	Count	16-bit decimal display
UnC24	User position feedback	Command unit	16-bit decimal display

Note: *1. Refer to "9.4 Input signal monitoring".

*2. Refer to "9.5 Output signal monitoring".

*3. Refer to "9.3 How to read 32-bit decimal display".

9.2 Monitor display operation example

For details, refer to "5.2.8 Monitor display (Un □□□) operation".

9.3 How to read 32-bit decimal display

For details, refer to "5.2.6 Numerical value setting type".

9.4 Input signal monitoring

The status of input signals can be checked using "Input signal monitoring (Un005)". The confirmation procedure, display determination method, and display examples are shown below.

9.4.1 Input signal status confirmation

The steps to check the input signal status via Un005 are as follows:

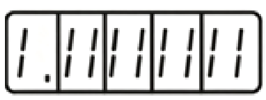
(1) Press the key M to switch to the monitor function mode display " Un005 ".

(2) After pressing and holding the key S for 1 second, the current status is displayed. The status is shown on the panel operator's segments. Refer to "8.4.2 Input signal display status determination method" for how to read the display.

(3) Press and hold the key S for about 1 second to return to the " Un005 " display.

9.4.2 Input signal display status determination method

The status of the assigned input signal is displayed by the lighting status of the segments (LEDs) on the panel operator. The correspondence between input pins and LED numbers is shown in the table below.



Upper (H level)
Lower (L level)
8 7 6 5 4 3 2 1 Number

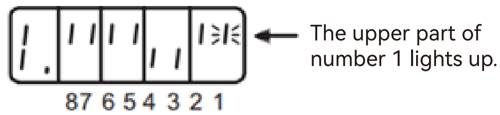
- When the input signal is at H level, the upper segment (LED) lights up.
- When the input signal is at H level, the lower segment (LED) lights up.

Display LED number	Output pin number	Pin name
1	CN1-10	DI1
2	CN1-9	DI2
3	CN1-8	DI3
4	CN1-7	DI4
5	CN1-11	DI5
6	—	—
7	—	—
8	—	—

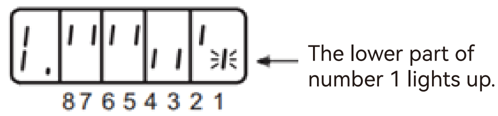
9.4.3 Input signal display example

An example of the input signal display is shown below:

- When DI1 signal is at H level



- When DI1 signal is at L level



9.5 Output signal monitoring

The status of output signals can be checked using "Output signal monitoring (Un006)". The confirmation procedure, display determination method, and display examples are shown below.

9.5.1 Output signal status confirmation

The steps to check the output signal status via Un006 are as follows:

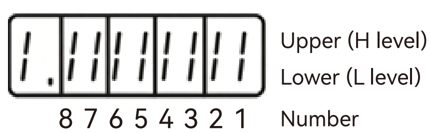
(1) Press the key M to switch to the monitor function mode display " Un006 ".

(2) After pressing and holding the key S for 1 second, the current status is displayed. The status is shown on the panel operator's segments. Refer to “8.5.2 Determining the display status of output signals” for how to read the display.

(3) Press and hold the key S for about 1 second to return to the " Un006 " display.

9.5.2 Output signal display status determination method

The status of the assigned output signal is displayed by the lighting status of the segments (LEDs) on the panel operator. The correspondence between output pins and LED numbers is shown in the table below.



- When the output signal is at H level, the upper segment (LED) lights up.
- When the output signal is at L level, the lower segment (LED) lights up.

Display LED number	Output pin number	Pin name
1	CN1-1，-6	DO1
2	CN1-2，-3	DO2
3	CN1-4，-5	DO3
4	—	—
5	—	—
6	—	—
7	—	—
8	—	—

9.5.3 Output signal display example

An example of the output signal display is shown below.

- When the DO1 signal is active (H level active)

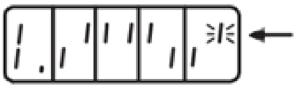


图 12-41 Monitor Display at Startup

9.6 Monitoring display at Power-ON

If set Un number through Pn52F, the data of the Un number will be displayed on the operation panel when the power is turned on. However, if it has been set to FFF [Default value], the status (bb, run, etc.) will be displayed when the power is turned on.

Table 9-2 Pn52F parameter setting

Pn52F	Monitor Display at Startup		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Default value	Immediately	Setup
	0-FFF	——	FFF		

Chapter 10 Alarm & Warning Display

10.1 Alarm display

This section explains the processing method when an alarm occurs.

" 10.1.1 Alarm list" explains the 603F error code, the alarm name, the alarm content, the stop method when the alarm occurs, and whether the alarm can be reset.

" 10.1.2 Causes and troubleshooting" explains the causes of alarms and their treatment methods.

10.1.1 Alarm list

How to stop the alarm:

BM.1: Depends on Pn001.0. The default setting decelerates and stops the motor based on the deceleration time of Pn30A, then enters free control mode after stopping.

BM.2: Depends on Pn00B.1.The default setting is configured to stop the motor at the maximum deceleration torque value set for Pn406. After stopping, the motor enters BD control mode.

For torque control, generally use BM.1 to stop. By setting Pn00B.1 = 1, the same stop method as BM.1 can be set. When using multiple servo motors, this stop method can be used to prevent damage to the machine due to different stop methods.

Whether the alarm can be reset:

Yes: The alarm can be cleared by alarm reset. However, if the cause of the alarm is not completely eliminated, the alarm cannot be dismissed.

No: The alarm cannot be cleared by alarm reset .

The alarm list is as follows:

Table 10-1 Alarm list

Alarm No.	603F error code	Alert name	Content	How to stop when an alarm occurs	Whether the alarm can be reset (N/Y)
A.020	0x0020	Parameter checksum error	There is an error in the parameter data in the servo drive.	BM.1	N
A.021	0x0021	Parameter format error	There is an error in the parameter data format in the servo drive.	BM.1	N
A.022	0x0022	System checksum error	There is an error in the parameter data in the servo drive.	BM.1	N
A.030	0x0030	Main circuit detector error	There is an error in the detection data for the main circuit.	BM.1	Y
A.040	0x0040	Parameter setting error	A parameter setting is outside of the setting range.	BM.1	N
	0x0040	Output pin definition repetition	Output pin definition is repeated.	BM.1	N
A.042	0x0042	Parameter combination error	The combination of some parameters exceeds the setting range.	BM.1	N
A.04A	0x004A	Parameter setting error 2	There is an error in parameter setting.	BM.1	N
A.050	0x0050	Combination error	The capacities of the servo drive and servo motor do not match.	BM.1	Y
A.051	0x0051	Unsupported device alarm	An unsupported device is connected.	BM.1	N
A.056	0x0056	Model information mismatch	The model information type is inconsistent with the default setting.	BM.1	N

A.057	0x0057	Program exception or mismatch	The firmware type is inconsistent with the default setting.	BM.1	N
A.080	0x0080	Linear encoder optical scale pitch setting abnormal	The value of the linear encoder grating pitch (Pn282) remains at its default setting.	BM.1	N
A.0B0	0x00B0	Invalid servo ON command alarm	After executing the auxiliary function to power on the motor, the servo ON input (/S-ON) signal is input from the host controller.	BM.1	Y
A.100	0x0100	Overcurrent detection	An overcurrent flows through the power transistor or the heat sink overheated.	BM.1	N
A.102	0x0102	Current detection error	UVW and PE wiring error.	BM.1	N
A.300	0x0300	Regeneration error	There is an error related to regeneration.	BM.1	Y
A.320	0x0320	Regenerative overload	A regenerative overload occurred	BM.2	Y
A.330	0x0330	Main circuit power supply wiring error	The AC power supply input setting or DC power supply input setting is not correct. The power supply wiring is not correct.	BM.1	Y
A.331	0x0331	Power-related input signal abnormality	Power-related input signal abnormality.	BM.1	N
A.400	0x0400	Overvoltage	The main circuit DC voltage is too high.	BM.1	Y
A.410	0x0410	Undervoltage	The main circuit DC voltage is too low.	BM.2	Y
A.520	0x0520	Vibration alarm	Abnormal oscillation is detected in the motor speed.	BM.1	Y
A.521	0x0521	Autotuning alarm	Vibration is detected during autotuning for the tuning-free function.	BM.1	Y
A.710	0x0710	Instantaneous overload	The servo motor is operating for several seconds to several tens of seconds under a torque that largely exceeded the rating.	BM.2	Y
A.720	0x0720	Continuous overload	The servo motor is operating continuously under a torque that exceeded the rating.	BM.1	Y
A.730 A.731	0x0730 0x0731	Dynamic brake overload	When the dynamic brake is applied, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	BM.1	Y
A.740	0x0740	Inrush current limiting resistor overload	The main circuit power supply is being switched on too frequently.	BM.1	Y
A.750	0x0750	User-defined torque overload	The torque exceeds the user-set value.	BM.2	N
A.810	0x0810	Encoder backup alarm	The power supplies to the encoder all fails and the position data is lost.	BM.1	N
A.820	0x0820	Encoder checksum alarm	There is an error in the checksum results for encoder memory.	BM.1	N
A.830	0x0830	Encoder battery alarm	The battery voltage is lower than the specified level after the control power supply is turned ON.	BM.1	Y
A.840	0x0840	Encoder data alarm	There is an internal data error in the encoder.	BM.1	N
A.850	0x0850	Encoder overspeed	The encoder was operating at high speed when the power was turned ON.	BM.1	N
A.860	0x0860	Encoder overheating	The internal temperature of the encoder is too high .	BM.1	N
A.891	0x0891	Encoder module failure	The linear encoder is abnormal.	BM.1	N
A.B31	0x0B31	Current detection error 1	The error of U-phase current detection circuit occur.	BM.1	N

A.B32	0x0B32	Current detection error 2	The error of V-phase current detection circuit occur.	BM.1	N
A.B33	0x0B33	Current detection error 3	The error of current detection circuit occur.	BM.1	N
A.BF2	0x0BF2	System alarm 2	Current control processing unit program malfunction.	BM.1	N
A.BF4	0x0BF4	System alarm 4	CPU WDT fault.	BM.1	N
A.BF5	0x0BF5	System alarm 5	Parameter batch transmission error.	BM.1	N
A.C10	0x0C10	Servomotor out of control	The servo motor is out of control.	BM.1	Y
A.C21	0x0C21	Hall sensor signal abnormality	Hall-effect sensor failure.	BM.1	N
A.C50	0x0C50	Polarity detection failure	Polarity detection failure	BM.1	N
A.C51	0x0C51	Polarity detection exceeds positive/negative limit	The overtravel signal is detected during polarity detection.	BM.1	Y
A.C52	0x0C52	Polarity detection not completed	The servo is turned ON before the polarity is detected.	BM.1	Y
A.C53	0x0C53	Out of range of motion for polarity detection	The travel distance exceeds the setting of Pn48E (Polarity detection range).	BM.1	N
A.C54	0x0C54	Polarity detection failure 2	The polarity detection fails.	BM.1	N
A.C80	0x0C80	Encoder clear error （multiturn upper limit setting error）	The multiturn data for the absolute encoder is not correctly cleared or set.	BM.1	N
A.C90	0x0C90	Encoder communications error	The encoder and servo drive cannot communicate with each other.	BM.1	N
A.C91	0x0C91	Encoder communications position data acceleration rate error	An error occurs in calculating the position data of the encoder.	BM.1	N
A.CA0	0x0CA0	Encoder parameter error	The encoder parameters are corrupted.	BM.1	N
A.CB0	0x0CB0	Encoder feedback checksum abnormality	The contents of communications with the encoder are incorrect.	BM.1	N
A.CC0	0x0CC0	Maximum rotation count mismatch	Different multiturn limits is set in the encoder and the servo drive.	BM.1	N
A.D00	0x0D00	Excessive position deviation	The setting of Pn520 (Excessive position deviation alarm level) is exceeded by the position deviation while the servo is ON.	BM.1	Y
A.D01	0x0D01	Excessive position deviation alarm at servo ON	The servo is turned ON after the position deviation exceeds the setting of Pn526 (Excessive position deviation alarm level at servo ON) while the servo is OFF.	BM.1	Y
A.D02	0x0D02	Excessive position deviation alarm for speed limit at servo ON	If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed limit level at servo ON) limits the speed when the servo is turned ON. This alarm occurs if reference pulses are input and the setting of Pn520 (Excessive position deviation alarm level) is exceeded before the limit is cleared.	BM.2	Y
A.EB1*	0x0EB1	STO input time abnormality	STO input time abnormality.	BM.1	N
A.F10	0x0F10	Power supply line open phase.	The voltage is low for more than one second for phase R, S, or T when the main power supply is ON.	BM.2	Y
A.F20	0x0F20	UVW phase loss	Phase loss in the U, V, W three-phase of the servo motor.	BM.1	N

A.F21	0x0F21	UVW phase sequence error	Phase sequence error in the U, V, W three-phase of the servo motor.	BM.1	N
A.F29	0x0F29	Network port reverse connection alarm	Network port reverse connection detected	BM.1	N
A.F30	0x0F30	Collision detection alarm	Alarm detected.	BM.1	Y
A.———	—	No error display	Normal operation.	—	—

10.1.2 Causes and troubleshooting

When the error occurs, the panel display will display“A. □□□ ".The causes of and corrections for the alarms are given in the following table.

If the fault still cannot be eliminated after following the table below, please contact the distributor or our company.

Table 10-2 Alarm causes and troubleshooting measures -1

Alarm No.: Alarm name	Causes	Confirmation method	Corrections
A.020: Parameter checksum error (There is an error in the parameter data in the servo drive.)	The power supply voltage drops suddenly .	Measure the power supply voltage. Check the timing of cutting off the power supply.	Set the power supply voltage within the specified range, and initialize the parameter settings (Fn005).
	The power supply is turned off while writing parameter settings.		Initialize the parameter settings (Fn005) and then set the parameters again.
	The number of times that parameters are written exceeds the limit.	Check to see if the parameters are frequently changed by the host controller.	The servo drive may be faulty. Replace the servo drive. Reconsider the method for writing the parameters.
	A malfunction is caused by noise from the AC power supply, ground, static electricity, or other sources.	Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, it may be due to noise.	Implement countermeasures against noise.
	Gas, water drops, or cutting oil enters the servo drive and causes failure of the internal components.	Confirm the installation environment.	The servo drive may be faulty. Replace the Servo drive.
	A failure occurs in the servo drive.	Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, the servo drive may have failed	The servo drive may be faulty. Replace the Servo drive.
A.021: Parameter format error (There is an error in the parameter data format in the servo drive.)	The software version of the parameters to be written is newer than that of the servo drive that caused the alarm.	Use Fn012 to see if the software versions are the same. If they are different, it could be the cause of the alarm.	Write the parameters from another servo drive with the same model and the same software version, and then turn the power OFF and ON again.
	A failure occurred in the servo drive	—	The servo drive may be faulty. Replace the Servo drive.
A.022: System checksum error (There is an error in the parameter data in the servo drive)	The power supply voltage drops suddenly	Measure power supply voltage	The servo drive may be faulty. Replace the Servo drive.
	The power supply is turned off while setting auxiliary functions.	Check the timing of turning off the power supply	The servo drive may be faulty. Replace the Servo drive.
	A failure occurred in the servo drive	Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, the servo drive may have failed	The servo drive may be faulty. Replace the Servo drive.

A.030: Main circuit detection part failure (Abnormal detection data of the main circuit)	A failure occurred in the servo drive	—	The servo drive may be faulty. Replace the Servo drive.
A.040: Parameter setting error/Duplicate output pin definitions Parameter setting out of the set range/ Duplicate output pin definitions	The capacity of the servo drive does not match the capacity of the servo motor.	Confirm the capacity and combination of the servo drive and servo motor.	Match the capacities of the servo drive and the servo motor.
	Servo drive failure	—	The servo drive may be faulty. Replace the Servo drive.
	A parameter setting is out of the set range.	Confirm the setting range of the changed parameter.	Make the changed parameter a value within the setting range.
	The set value of the electronic gear ratio is out of the set range.	Confirm whether the electronic gear ratio is 0.001 < (Pn78C/ Pn78E) <Encoder resolution * 0.4.	Set the electronic gear ratio to 0.001 <(Pn78C/ Pn78E) <Encoder resolution * 0.4.
A.042*1: Parameter combination error (Combination of multiple parameters exceeds the specified range)	The speed of program jogging goes below the setting range when the electronic gear ratio (Pn78C/Pn78E) or the servo motor is changed.	Check to see if the detection conditions*1 are satisfied.	Decrease the setting of the electronic gear ratio (Pn78C/Pn78E).
	Due to the change in the program JOG movement speed (Pn533), the speed of program JOG operation (Fn004) is out of the set range.	Check to see if the detection conditions*1 are satisfied.	Increase the setting of Pn533.
	Due to changing the electronic gear ratio (Pn78C/Pn78E) or the servo motor, the advanced auto-tuning movement speed is out of the set range.	Check to see if the detection conditions*1 are satisfied.	Decrease the setting of the electronic gear ratio (Pn78C/Pn78E).
A.04A: Parameter setting abnormality 2 (Parameter setting abnormality)	When registering 4-byte parameters to the library group, two groups are not consecutively registered.	—	Change the number of bytes of the library group to an appropriate value.
	When the total number of library data exceeds 64 (Pn900/Pn901 > 64).	—	Keep the total number of library data below 64.
A.050: Combination error(Out of the allowable combined motor capacity range)	The servo drive and servo motor capacities do not match each other.	Confirm(Motor capacity)/(Servo drive capacity) ≤ 1/4 or(Motor capacity)/(Servo drive capacity) ≤ 4	Select a proper combination of the servo drive and servo motor capacities.
	A failure occurred in the encoder.	Replace with another servo motor, confirm that the alarm does not occur again	Replace servo motor or encoder.
	A failure occurred in the servo drive.	—	The servo drive may be faulty. Replace the servo drive.
A.051: Non-support of alarm by product	An unsupported serial converter unit or encoder (e.g., an external encoder) is connected to the servo drive	Check the product combination specifications.	Change to a correct combination of models.
A.056: Model information mismatch	Model information type is inconsistent with the default setting.	Check whether the drive model in the debugging software matches the nameplate.	Update the model information or contact technical personnel.
A.057: Program error or mismatch	Program error or mismatch	—	Return to factory or contact technical personnel.

A.080: Linear encoder grating pitch setting abnormality	Linear encoder grating pitch (pn282) setting remains at default setting.	Verify the value of Pn282	Set Pn282 correctly.
A.0B0: Invalid servo ON command alarm	After executing the auxiliary function to power on the motor, the servo ON input (/SON) signal is sent from the host controller.	—	Turn the power supply to the servo drive OFF and ON again. Or, execute a software reset.

***Note: 1. An alarm is detected when either of the following two detection condition formulas is satisfied.**

Pn533 [min − 1] × (Encoder resolution) /(6 × 10 ^{5}) ≤ Pn78C/Pn78E

Max. motor speed [min − 1] ×(Encoder resolution)/(approx. 3.66×1012) ≥ Pn78C/Pn78E

Table 10-3 Alarm causes and troubleshooting measures -2

Alarm No.: Alarm name	Causes	Confirmation method	Corrections
A.100: Overcurrent detection (overcurrent flowing through power transistor or heatsink overheating).	The main circuit cable is not wired correctly or there is faulty contact.	Check if the wiring is correct.	Correct the wiring.
	There is a short-circuit or ground fault in a main circuit cable.	Check for short-circuits across the cable's U, V, W phases or between the ground and the cable's U, V, W phases.	The cable may be short circuited. Replace the cable.
	There is a short-circuit or ground fault inside the servo motor.	Check for short-circuits across the motor terminals' U, V, W phases or between the ground and the motor terminals' U, V, W phases.	The servo motor may be faulty. Replace the servo motor.
	There is a short-circuit or ground fault inside the servo drive.	Check for short-circuits across the servo drive's servomotor connection terminals (U, V, W) or between the ground and these terminals.	The servo motor may be faulty. Replace the servo motor.
	The regenerative resistor is not wired correctly or there is faulty contact.	Check if the wiring is correct.	Correct the wiring.
	The dynamic brake (DB, emergency stop executed from the servo drive) is frequently activated, or a DB overload alarm occurred.	Use the DB resistor power consumption (Un00B) to confirm the DB utilization frequency. Alternatively, check the alarm display (Fn000) for DB overload alarms (A.730/A.731).	Change the servo drive model, operating methods, or the mechanisms so that the dynamic brake does not need to be used so frequently.
	The regenerative processing capacity is exceeded.	Use the regenerative load ratio (Un00A) to confirm the regenerative resistor usage frequency.	Recheck the operating conditions and load.
	The servo drive regenerative resistance is too small.	Use the regenerative load ratio (Un00A) to confirm the regenerative resistor usage frequency.	Change the regenerative resistance to a value larger than the servo drive minimum allowable resistance.
	A heavy load is applied while the servomotor is stopped or running at a low speed.	Check if the operating conditions exceed the servo drive's specification range.	Reduce the load applied to the servomotor. Or, increase the operating speed.
	A malfunction is caused by noise.	Improve the noise environment—e.g., by rerouting wiring or optimizing installation conditions—and check if there's an improvement.	Implement countermeasures against noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVOPACK's main circuit wire size.
	Servo drive failure.	—	Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.102: Current detection abnormality	Check for incorrect phase sequence of UVW and PE.	Phase sequence of UVW and PE	Replace with the correct phase sequence of UVW and PE.

A.300: Regeneration failure	Set the regenerative resistor capacity (Pn600) to a value other than "0", but there is no external regenerative resistor.	Check the connection of external regenerative resistor and the value of Pn600	Connect an external regenerative resistor, or set Pn600 to 0 when no regenerative resistor is required.
	There is no external regenerative resistor, and the jumper wire between the servo drive's power terminals B2-B3 is disconnected.	Confirm the wiring of the power terminal jumper	Connect the jumper wiring correctly.
	Poor wiring, disconnection, or broken wire in the external regenerative resistor.	Check the wiring of the external regenerative resistor	Correctly wire the external regenerative resistor.
	Servo drive failure	—	If the control power supply is turned on again without the main circuit power supply being turned on, if the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.320: Regenerative overload	The power supply voltage exceeds the specified range	Measure power supply voltage.	Set the power supply voltage within the specified range.
	The external regenerative resistance value or regenerative resistor capacity is too small, or there has been a continuous regeneration state	Check the operating conditions or the capacity.	Change the regenerative resistance value or capacity. Reconsider the operating conditions.
	There is a continuous regeneration state because a negative load is continuously applied	Check the load applied to the servomotor during operation.	Reconsider the system including the servo, machine, and operating conditions.
	The setting of Pn600 (regenerative resistor capacity) is smaller than the capacity of the external regenerative resistor	Check to see if a regenerative resistor is connected and check the setting of Pn600.	Correct the setting of Pn600.
	External regenerative resistor value is too large	Check if the regenerative resistor value is correct.	Change it to the correct resistor value and capacitance.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.

A.330: Main circuit power wiring error * Detected when the main circuit power supply is turned on	The power supply voltage inside the servo drive is too high, and the regenerative resistor is disconnected	Measure the resistance value of the regenerative resistor with a measuring instrument.	When using the built-in regenerative resistor of the servo drive, replace the servo drive. When using an external regenerative resistor, replace the regenerative resistor.
	DC power is supplied when an AC power supply input is specified in the settings	Confirm whether the power supply is DC power supply.	Correct the power supply setting to match the actual power supply.
	AC power is supplied when a DC power supply input is specified in the settings	Confirm whether the power supply is AC power supply.	Correct the power supply setting to match the actual power supply.
	Set the regenerative resistor capacity (Pn600) to a value other than "0", but there is no external regenerative resistor	Confirm the connection of the external regenerative resistor and the value of Pn600.	Connect an external regenerative resistor, or set Pn600 to 0 when an external regenerative resistor is not required.
	The jumper wires of the servo power supply terminals B2-B3 of capacities other than the above are disconnected	Confirm the wiring of the power terminal jumper	Connect the jumper wires correctly.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.331: Power-related input signal abnormality (Abnormal rapid discharge during power failure)	DC power input selection (Pn001.2) and rapid discharge selection during DC power input (Pn00E.1) enabled, rapid discharge initiated After CONVINSIGDISCHERRCHK_TIME elapses, voltage drop falls below DCVOLT10V	Measure the voltage drop during discharge.	Replace the servo drive.

A.400: Overvoltage (Detected in the main circuit power supply section of the servo drive)	The servo drive for AC200V, the AC power supply voltage is 290V or higher, or the servo drive for AC400V detects a power supply voltage of AC580V or higher.	Measure power supply voltage.	Correct the AC/DC power supply voltage to within specified range.
	The power supply is unstable or is affected by a lightning surge.	Measure power supply voltage.	Improve the power supply condition, install a surge suppressor, etc., and turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
	The servo drive accelerates or decelerates when the AC power supply voltage is between 230–270V (for 200V servo drives) or between 480–560V (for 400V servo drives)	Check the power supply voltage and the speed and torque during operation.	Set the AC power supply voltage within the specified range.
	The external regenerative resistance is too high for the operating conditions.	Check the operating conditions and the regenerative resistance.	Select a regenerative resistance value that is appropriate for the operating conditions an load.
	The moment of inertia ratio or mass ratio exceeds the allowable value.	Check to see if the moment of inertia ratio or mass ratio is within the allowable range.	Increase the deceleration time, or reduce the load.
	Servo drive failure	—	If the control power supply is turned on again without the main circuit power supply being turned on, if the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.410: Undervoltage(The undervoltage is detected by the main circuit power supply inside the servo drive)	For the AC200V servo drive, the AC power supply voltage is below 106V; for the AC400V servo drive, the AC power supply voltage is below 240V.	Measure power supply voltage.	Correct the power supply voltage to normal range.
	Power supply voltage drops during operation.	Measure power supply voltage.	Increase power supply capacity.
	A momentary power interruption occurs.	Measure power supply voltage.	If the momentary power failure holding time (Pn509) is changed, set it to a smaller value.
	The fuse of the servo drive is blown out.	—	Replace the servo drive and use the servo drive after connecting the reactor.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.520: Vibration alarm	Abnormal oscillation is detected in the motor speed	Check for abnormal motor noise, and check the speed and torque waveforms during operation.	Reduce the motor speed. Or, reduce the setting of Pn100 (Speed Loop Gain).
	The moment of inertia ratio (Pn103) is larger than the actual value or changes greatly.	Check moment of inertia ratio.	Correctly set the moment of inertia ratio (Pn103).

A.521: Autotuning alarm (Vibration detected during auto-tuning of the tuning-free function)	The servo motor vibrates significantly while performing the tuning-free function.	Check the waveform of the motor speed.	Reduce the load so that the moment of inertia ratio is within the allowable value. Or increase the load level or reduce the rigidity level in the tuning-less level settings.
	The motor vibrates significantly during advanced autotuning.	Check the waveform of the motor speed.	Check the operating procedure of corresponding function and implement corrections.
A.710: Instantaneous overload A.720: Continuous overlo	The wiring is not correct or there is a faulty connection in the motor or encoder wiring.	Check the wiring.	Make sure that the servo motor and encoder are correctly wired.
	Motor operation exceeds the overload protection characteristics.	Check the motor overload characteristics and operation command.	Reconsider the load and operating conditions. Or, increase the motor capacity.
	Motor fails to drive due to mechanical factors, causing excessive load during operation.	Check the operation reference and motor speed.	Correct the mechanical problem.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.730: A.731: Dynamic brake overload (An excessive power consumption by the dynamic brake is detected.)	The servo motor is rotated by an external force.	Check the operation status.	Do not drive the motor with an external force.
	Motor rotational energy during DB stop exceeds DB resistor capacity.	Use the DB resistor power consumption (Un00B) to confirm the DB utilization frequency.	Try the following measures: • Reduce the command speed of the servo motor. • Decrease the inertia ratio. • Reduce the number of DB stops.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.740: Inrush current limiting resistor overload (The main circuit power supply is frequently turned ON and OFF.)	The allowable frequency of the inrush current limiting resistor is exceeded when the main circuit power supply is turned ON and OFF	Confirm the number of times the power supply is turned ON/OFF.	Reduce the frequency of turning the main circuit power supply ON and OFF.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.750: User-defined torque overload (The torque exceeds the user-set value)	When function selection application switch 61F (Pn61F.0) is enabled, the system selects the current integration method depending on whether an independent air cooling coefficient is present—if the integral value exceeds the instantaneous overload alarm level.	Check servo components for overload behavior.	Stop overload.

A.810: Encoder backup alarm (Detected at the encoder, but only when an absolute encoder is used.)	The power to the absolute encoder is turned ON for the first time	Check to see if the power supply is turned ON for the first time.	Set up the encoder (Fn008).
	Reconnected after removing the encoder cable	Check to see if the power supply is turned ON for the first time.	Check the encoder connection and set up the encoder (Fn008).
	Power is not being supplied both from the control power supply (+5V) from the servo drive and from the battery power supply	Check the encoder connector battery and the connector status.	Replace the battery or implement similar measures to supply power to the encoder, and set up the encoder (Fn008).
	Absolute encoder failure	—	If the alarm cannot be cleared even if the setting operation is performed again, replace the servo motor.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
	Encoder failure	—	For absolute encoder: If alarms still occur frequently after re-setting the encoder (Fn008), the servo unit may be faulty. Replace the servo motor. For rotary absolute encoder or incremental encoder: The servo motor may be faulty. Replace the servo motor.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.830: Encoder battery alarm (The absolute encoder battery voltage is lower than the specified level.)	The battery connection is faulty or a battery is not connected.	Check the battery connection.	Correct the battery connection.
	The battery voltage is lower than the specified value (3.0V).	Measure the voltage of the battery.	Replace the battery.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.840: Encoder data alarm * Detected on the encoder side	Encoder malfunction	—	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor.
	Encoder malfunction due to interference such as noise	—	Correctly perform the wiring around the encoder. (Separation of the encoder cable and the main circuit cable of the servo motor, grounding treatment, etc.).
A.850: Encoder overspeed (Detected at the encoder when the control power supply is turned ON.)	When the control power is turned on, the servo motor rotates at a speed of 200rpm or more.	Check the motor speed when the power supply is turned ON.	Reduce the Servomotor speed to a value less than 200 rpm, and turn ON the control power supply.
	Encoder failure	—	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor.
	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.

A.860: Encoder over-heating * Only detected when an absolute encoder is connected * Detected on the encoder side	The ambient temperature of the servo motor is too high	Measure the ambient temperature of the servo motor.	Reduce the ambient temperature of the servo motor to 40° C or less.
	The servo motor load is greater than the rated load.	Use the accumulated load ratio (Un009) to check the load.	Operate the servo drive so that the motor load remains within the speci-fied range.
	Encoder failure	—	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor.
	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.891: Encoder module fault	Encoder failure	—	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Repair or replace the servo motor.
A.B31: Current detection error 1	U-phase current detection circuit failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.B32: Current detection error 2	V-phase current detection circuit failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.B33: Current detection error 3	Current detection circuit failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
	The main circuit cable of the servo motor is disconnected	Check whether the main circuit cable of the servo motor is disconnected	Repair the motor cable.
A. BF2: System alarm 2 (Current control pro-cessing unit program malfunction)	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A. BF4: System alarm 4 (CPUwDT fault)	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A. BF5: System alarm 5 (Parameter batch transfer abnormality)	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.C10: Prevent loss of control detection *Detected when servo is ON (servo motor loss of control)	The order of phases U, V, and W in the motor wiring is incorrect.	Confirm the servo motor wiring	Make sure that the servo motor is correctly wired.
	Encoder failure	—	If the motor wiring is correct and the alarm still occurs after turning the power supply OFF and ON again, the servo motor may be faulty. Replace the servo motor.
	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.

A.C21: Hall sensor signal abnormality（Hall sensor fault）	Magnetic pole sensor is exposed outside the motor stator.	Check the magnetic pole sensor	Reinstall the motor rotor or stator.
	The wiring of the magnetic pole sensor is incorrect.	Check the wiring of the magnetic pole sensor	Correct the wiring of the magnetic pole sensor.
	Magnetic pole sensor fault	—	Replace the magnetic pole sensor.
A.C50: Magnetic pole detection failure	Incorrect parameter setting	Check the specifications of the linear encoder and the status of the feed-back signal.	The pitch of the linear encoder grating scale (Pn282) and the motor phase sequence selection (Pn080) may not match the device status. Set the parameters correctly.
	Grating scale signal interference	Check the connection between the serial conversion unit, the FG of the servo motor and the FG of the servo drive, and the connection between the FG of the servo drive and the FG of the power supply. In addition, confirm that the cable of the linear encoder is properly shielded, and check whether the detection com-mand is repeatedly output in the same direction multiple times.	Take appropriate anti-interference measures for the linear encoder cable.
	External force applied to the motor rotor	—	When an external force, such as cable tension, is applied to the motor rotor, even if the detection command is 0, if the speed feedback is not 0, it cannot be detected smoothly. Reduce the external force to make the speed feedback 0. If the external force cannot be reduced, increase the magnetic pole detection speed loop gain (Pn481).
	Low resolution of the linear encoder	Check if the pitch of the linear encoder grating scale is within 100 micrometers.	When the pitch of the linear encoder grating scale is 100 micrometers or more, the servo drive cannot detect the correct speed feedback. Use a high-precision linear encoder grating scale with a pitch (recommended within 40 micrometers), or increase the magnetic pole detection com-mand speed (Pn485). However, the motor operation range during mag-netic pole detection will increase.
A.C51: Pole detection exceeds positive/nega-tive limit（(An overshoot signal is detected during pole detection.))	Magnetic pole detection speed ratio signal	Confirm speed ratio position	Connect the speed ratio signal. Perform magnetic pole detection at positions where the speed ratio signal cannot be detected.

A.C52: Magnetic pole detection incomplete (Servo ON in state where magnetic pole detection is incomplete.)	When using an absolute linear encoder, select a setting (Pn587) that cannot detect magnetic poles via the absolute linear encoder. The servo will turn ON while the magnetic pole detection status is undefined.	—	When using an absolute linear encoder, select the setting (Pn587) to detect magnetic poles via the absolute linear encoder.
A.C53: Out of the magnetic pole detection movable range (Movement during magnetic pole detection exceeded the set value (Pn48E).)	Detected distance from center pole exceeds magnetic pole detection range (Pn48E).	—	Expand the magnetic pole detection range (Pn48E), or increase the magnetic pole detection speed loop gain (Pn481).
A.C54: Magnetic pole detection failure 2	Subjected to external forces	—	Increase the value of the pole detection confirmation thrust command (Pn495) and increase the value of the pole detection error tolerance range (Pn498). However, expanding the error tolerance range will cause the motor temperature to rise.
A.C80: Encoder clear error or multiturn upper limit setting abnormality	Encoder failure	—	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor.
	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.C90: Encoder communication fault (The encoder and servo drive cannot communicate with each other.)	There is a faulty contact in the connector, or the connector is not wired correctly for the encoder.	Check the condition of the encoder connector.	Reconnect the encoder connector and check the encoder wiring.
	There is a cable disconnection or a short circuit in the encoder. Or, the cable impedance is out of the specified values.	Check the condition of the encoder cable.	Use the encoder cable within the specified specifications.
	One of the following occurs: corrosion caused by improper temperature, humidity, or gas; a short circuit caused by the entry of water drops or cutting oil; or faulty contact in a connector caused by vibration.	Check the operating environment.	Improve the operating environment, and replace the cable. If the alarm still occurs, replace the servo drive.
	Malfunction due to noise interference	—	Correct the wiring around the encoder by separating the encoder cable from the servo motor main circuit cable or by grounding the encoder.
	Servo drive failure	—	If the alarm does not occur when the control power is turned on after connecting the servo motor to another servo drive, the servo drive may be faulty. Replace the servo drive.

A.C91: Encoder communications position data acceleration rate error (A fault occurred in the calculation of the encoder's position data.)	Noise entered on the signal lines because the encoder cable is bent or the sheath is damaged	Check the condition of the encoder cable and connectors.	Check the encoder cable to see if it is installed correctly.
	The encoder cable is bundled with a high current line or installed near a high current line	Check the setting condition of the encoder cable.	Confirm that there is no surge voltage on the encoder cable.
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Check the setting condition of the encoder cable.	Properly ground the machine to separate it from the FG of the encoder.
A.CA0: Encoder parameter error (Encoder parameters is corrupted.)	Encoder failure	—	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor.
	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor.
A.CB0: Encoder feedback checksum abnormality (Error in communication content with the encoder)	Encoder wiring is incorrect or has poor contact.	Check the wiring of the encoder.	Make sure that the encoder is correctly wired.
	The encoder cable has different specifications and is subject to noise interference.	-	Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2.
	The encoder cable has an excessively long wiring distance and is subject to noise interference.	-	The maximum wiring distance is 50m.
	The FG potential fluctuates due to the influence of motor-side equipment (e.g., welding machines).	Check the condition of the encoder cable and connectors.	Properly ground the machine to separate it from the FG of the encoder.
	The encoder is subject to excessive vibration shock.	Check the operating conditions.	Reduce machine vibration. Correctly install the servo motor.
	Encoder failure	-	Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor.
	Servo drive failure	-	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.CC0: Maximum rotation count mismatch (Mismatch between the encoder and servo drive maximum rotation counts)	The DD motor's maximum rotation count (Pn205) differs from the encoder's maximum rotation count.	Check the setting of Pn205	Correct the setting of Pn205 (0 to 65,535).
	The encoder's maximum rotation count differs from the servo drive's, or the maximum rotation count has been changed.	Check the setting of Pn205 in the servo drive	Change the setting Fn013 if the alarm occurs.
	Servo drive failure	-	Turn on the power again. If the alarm still occurs, the servo drive may be faulty and replace the servo drive.

A.D00: Excessive position deviation (The setting of Pn520 (Excessive position deviation alarm level) is exceeded by the position deviation while the servo was ON.)	The Servomotor U, V, and W wiring is not correct	Check the wiring of the servomotor's main circuit cables	Make sure that there are no faulty contacts in the wiring for the servo-motor and encoder.
	The servo drive's gain is too low	Verify whether the servo drive's gain is excessively low	Increase servo gain parameters such as Pn100 and Pn102.
	Higher frequency of position com-mands	Try operating the drive after reducing the command pulse frequency.	Reduce the position reference pulse frequency or the reference accelera-tion rate, or reconsider the electronic gear ratio.
	Acceleration of position command is too large.	Try operating the drive after reducing the command acceleration.	Apply smoothing, i.e., by using Pn216 (Position reference acceleration/ deceleration time constant).
	The setting of Pn520 (Excessive position deviation alarm level) is too low for the operating conditions.	Check Pn520 (Excessive position deviation alarm level) to see if it is set to an appropriate value.	Correctly set Pn520.
	Servo drive failure	-	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.D01: Excessive posi-tion deviation alarm at servo ON	Turn the servo ON if the position deviation exceeds the Pn526 set value while the servo is OFF.	Check the position deviation at servo ON (Un008).	Make settings to clear the position deviation at servo ON, or set the correct excessive position deviation alarm value (Pn526) when the servo is ON.
A.D02: Excessive position deviation alarm caused by speed limit at servo ON	When the position deviation is accumulating, turn the servo ON—the speed is limited by the servo ON speed limit (Pn529). If a position command is input in this state, it will exceed the set value of the excessive position deviation alarm (Pn520).	-	Set the position deviation to be cleared while the servo is OFF. Opti-mize the setting of Pn520 (Excessive position deviation alarm level). Or, adjust the setting of Pn529 or Pn584 (Speed limit level at servo ON)
A.EB1: Safety function signal input timing error	The delay between activation of the /HWBB1 and /HWBB2 input signals for the HWBB was ten second or longer.	Measure the time delay between the /HWBB1 and /HWBB2 signals.	The output signal circuits or devices for /HWBB1 and /HWBB2 or the servo drive input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Check to see if any of these items are faulty or have been disconnected.
A.F10: Power supply line phase loss detection during main circuit power-on (A low voltage state in one of the R, S, T phases lasting for more than 1 second when the main power is ON.)	Poor wiring of the three-phase power supply	Check the power supply wiring.	Make sure that the power supply is correctly wired.
	Three-phase power supply imbalance	Measure the voltage for each phase of the three-phase power supply.	Balance the power supply by chang-ing phases.
	Directly input single-phase power without setting the single-phase input parameter (Pn00B.2 = 1).	Check the power supply and the parameter setting.	Match the parameter setting to the power supply.
	Servo drive failure	-	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.

A.F20: UVW phase loss (Three-phase (U, V, W) phase loss input for the servo motor)	The value of (q-axis current command - q-axis current feedback) (Pn652) falls below the threshold (Pn651) repeatedly.	Check if the UVW cable is disconnected.	Connect the UVW cable.
A.F21: UVW phase sequence error (Three-phase (U, V, W) phase sequence error of the servo motor.)	UVW wire sequence error	Check the UVW wire sequence.	Replace with the correct UVW wire sequence.
A.F29: Reverse Ethernet port insertion alarm	Ethernet port is inserted backwards.	Verify the Ethernet port wiring.	Connect the wiring correctly.
A.F30: Collision detection alarm	Current torque command exceeds maximum collision torque.	Check if servo components are in collision.	Stop collision.

10.2 Warning display

This section explains how to deal with warnings.

" 10.2.1 Warning list" explains the 603F error code, the warning name, and the warning content.

10.2.1 Warning list

The list of warnings is as follows:

Table 10-4 Warning list

NO.	603F error code	Name	Content
A.900	0x0900	Excessive position deviation	In the servo ON state, the position deviation has exceeded the position deviation alarm threshold (Pn520).
A.901	0x0901	Excessive position deviation at servo ON	When the servo is OFF and the position deviation exceeds the set value at Pn526, the servo turns ON.
A.910	0x0910	Overload warning	Operated with torque significantly exceeding rated value.
A.911	0x0911	Vibration	Detected abnormal vibration in motor speed.
A.912	0x0912	Internal temperature warning 1	The heat sink temperature of the control circuit is abnormal.
A.920	0x0920	Regenerative overload	A regenerative overload occurs.
A.921	0x0921	Dynamic brake overload	Due to DB (Dynamic Braking) operation, rotational energy exceeds the capacity of the DB resistor.
A.924	0x0924	Regenerative warning	The result of regenerative braking activation does not match the settings.
A.930	0x0930	Absolute encoder battery failure	After turning on the control power supply, the battery voltage is below the specified value.
A.941	0x0941	Parameter change requiring re-powering	Parameters requiring re-powering is modified.
A.942	0x0942	Speed pulse compensation information inconsistency	The speed ripple compensation information stored in the encoder and servo drive differs.
A.94A	0x094A	Data setting warning (User constant number)	Data setting warning (User constant number).
A.94B	0x094B	Data setting warning (Out of data range)	Data setting warning (Outside data range).
A.94D	0x094D	Data setting warning（Data size error)	Data setting warning（Data size error)
A.94F	0x094F	Hardware parameter information anomaly	Hardware information checksum error.
A.95A	0x095A	Command warning (Conditions not met)	Command warning (Conditions not met)

A.95D	0x095D	Command warning (command interference)	Command warning (command interference)
A.971	0x0971	Undervoltage	Warning before the Undervoltage (A.410) alarm is triggered. Continuing operation may cause the Undervoltage (A.410) alarm to occur.
A.9A0	0x09A0	Overtravel	Positive/Negative limit overtravel.
A.9B0	0x09B0	Soft limit error	Soft limit setting error, check 607d.
A.9B2	0x09B2	Synchronization frame lost	Synchronization frame data loss.
A.9B3	0x09B3	Bus interruption	EtherCAT communication interrupted.
A.9B4	0x09B4	Network initialization failure	EtherCAT network initialization failed.
A.9C0	0x09C0	Advanced auto-tuning warning 1	Advanced auto-tuning warning 1
A.9C1	0x09C1	Advanced auto-tuning warning 2	Advanced auto-tuning warning 2
A.9C2	0x09C2	Advanced auto-tuning warning 3	Advanced auto-tuning warning 3
A.9C3	0x09C3	Advanced auto-tuning warning 4	Advanced auto-tuning warning 4
A.9C4	0x09C4	Advanced auto-tuning warning 5	Advanced auto-tuning warning 5
A.9C5	0x09C5	Advanced auto-tuning warning 6	Advanced auto-tuning warning 6
A.9C6	0x09C6	Advanced auto-tuning warning 7	Advanced auto-tuning warning 7
A.9C7	0x09C7	Advanced auto-tuning warning 8	Advanced auto-tuning warning 8
A.9C8	0x09C8	Advanced auto-tuning warning 9	Advanced auto-tuning warning 9
A.9C9	0x09C9	Advanced auto-tuning warning 10	Advanced auto-tuning warning 10
A.9CA	0x09CA	Advanced auto-tuning warning 11	Advanced auto-tuning warning 11
A.9CB	0x09CB	Advanced auto-tuning warning 12	Advanced auto-tuning warning 12
A.9CC	0x09CC	Advanced auto-tuning warning 13	Advanced auto-tuning warning 13
A.9CD	0x09CD	Advanced auto-tuning warning 14	Advanced auto-tuning warning 14
A.9CE	0x09CE	Advanced auto-tuning warning 15	Advanced auto-tuning warning 15
A.9CF	0x09CF	Advanced auto-tuning warning 16	Advanced auto-tuning warning 16
A.9D0	0x09D0	Advanced auto-tuning warning 17	Advanced auto-tuning warning 17
A.9D1	0x09D1	Advanced auto-tuning warning 18	Advanced auto-tuning warning 18
A.9D2	0x09D2	Advanced auto-tuning warning19	Advanced auto-tuning warning19
A.9D3	0x09D3	Advanced auto-tuning warning 20	Advanced auto-tuning warning 20

Note: 1. If it is not set to "Output Alarm Code and Warning Code (Pn001.3 = 1)", then no warning code will be output.

2. If it is set to " No Warning (Pn008.2 = 1)" , warnings other than undervoltage warning (A.971) will not be detected.

10.2.2 Causes and troubleshooting

The following table lists the causes of the warnings and the troubleshooting. If the error still cannot be eliminated after handling according to the table below, please contact the distributor or our company.

Table 10-5 Warning causes and troubleshooting

Alarm No.: Alarm name	Causes	Confirmation method	Corrections
A.900: Excessive position deviation	The servo motor U, V, and W wiring is not correct.	Check the wiring of the servo motor's main circuit cables.	Check the motor cable or encoder cable for issues like poor contact.
	The gain of the servo drive is too low.	Check the gains of the servo drive.	Increase the servo gain using advanced auto-tuning, etc.
	The frequency of the position reference pulse is too high.	Reduce the reference pulse frequency and try operating the servo drive.	Reduce the position instruction pulse frequency or instruction acceleration, or adjust the electronic gear ratio.
	The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the servo drive.	Apply smoothing, i.e., by using Pn216/217 (Position reference acceleration/ Deceleration time constant).
	Relative to the operating conditions, the position deviation excessive alarm value (Pn520) is low.	Check if position deviation excessive alarm value (Pn520) is appropriate .	Set correctly Pn520 value.
	Servo drive failure	—	Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.901: Excessive position deviation alarm at servo ON	The position deviation when the servo is turned ON exceeds the percentage set with the following formula: (Pn520×Pn51E)÷100	Check deviation counter Un008 when servo is OFF.	Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn528 (Excessive position deviation alarm level at servo ON)
A.910: Overload (warning before an A.710 or A.720 alarm occurs)	The wiring is incorrect or there is a faulty connection in the motor or encoder wiring.	Check the wiring	Make sure that the motor and encoder are correctly wired.
	The motor's operation exceeds the overload protection characteristic.	Check the motor overload characteristics and operation command.	Reconsider the load and operating conditions. Or, increase the motor capacity.
	Due to mechanical factors, the motor fails to drive, leading to excessive load during operation.	Check the operation command and motor speed.	Remove the mechanical problem.
	Servo drive failure	—	It may be that the servo drive is faulty. Replace the servo drive.
A.911: Vibration	Abnormal vibration is detected during motor operation.	Check the motor's abnormal noise, as well as its operating speed and torque waveform during operation.	Reduce the motor speed or lower the servo gain using single-parameter tuning, etc.
	The setting of Pn103 (Moment of Inertia Ratio) is greater than the actual moment of inertia or is greatly changed.	Check the inertia (of the motor).	Correctly set the inertia ratio (Pn103).

A.912: Internal temperature warning 1 Abnormal temperature detected in the control circuit's heat sink)	Ambient temperature is too high.	Measure ambient temperature with a thermometer or verify operational status via the servo drive's environmental monitoring settings.	Optimize servo drive settings and reduce ambient temperature.
	Operation resumed after repeatedly resetting the overload alarm by turning off the power.	Use the alarm display to confirm whether an overload alarm has occurred.	Modify alarm reset procedures.
	Excessive load, or operation exceeding the regenerative processing capacity.	Verify the load during operation through the cumulative load rate and confirm the regenerative processing capacity via the regenerative load rate.	Re-evaluate load conditions and operating parameters.
	Unsuitable installation orientation of the servo drive or improper spacing from other servo drives.	Confirm the servo drive's setting status.	Install according to servo drive mounting standards.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.920: Regenerative overload (warning before an A.320 alarm occurs)	Power supply voltage out of specification.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	Insufficient external regenerative resistor, servo drive, or regenerative resistor capacity, or continuous regeneration	Check the operating conditions or the capacity using the software HCServoWorks , etc.	regenerative resistance capacity, or servo drive capacity. Recheck the operating conditions using the HCServoWorks.
	Continuous negative load or continuous regeneration	Check the load applied to the servo motor during operation.	Recheck the system including the servo, machine, and operating conditions.
A.921: Dynamic brake overload (warning before an A.731 alarm occurs)	The servo motor is rotated by an external force.	Check the operation status.	Do not drive the motor with an external force.
	Motor rotational energy during DB stop exceeds DB resistor capacity.	Use the DB resistor power consumption (Un00B) to confirm the DB utilization frequency.	Try the following measures: • Reduce the command speed of the servo motor. • Decrease the inertia ratio. • Reduce the number of DB stops.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.
A.924: Regenerative warning (Regenerative function software settings do not match hardware)	Regenerative processing enabled via macro definition, DC power input disabled (Pn001.2), regenerative anomaly detected, external regeneration function enabled (Pn00E.3), and the built-in regenerative resistor is not selected.	Confirm that the parameters are set correctly.	Set correct parameters.
A.930: Absolute encoder battery faulty (The absolute encoder battery voltage is lower than the specified level.) *Detected only when an absolute encoder is connected	Poor or disconnected battery connection	Check the battery connection.	Correct the battery connection.
	Battery voltage below specified value (3.0V)	Measure the voltage of the battery.	Replace the battery.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.

A.941: Parameter change requiring re-powering	The parameters that requires re-powering are changed.	—	Turn the power supply to the servo drive OFF and ON again. ,
A.942: Speed ripple compensation information inconsistency (The speed ripple compensation information stored in the encoder and servo drive differs.)	The speed ripple compensation information stored within the encoder and servo drive differs.	Verify whether the speed ripple compensation information stored within the encoder and servo drive is consistent.	Modify the parameter information to the correct values.
A.94A: Data setting warning (User constant ID)	An invalid parameter is used.	Confirm the command that leads to this result.	Use the correct parameters.
A.94B: Data setting warning (Out of data range)	A value outside the specified range is set in the command data.	Confirm the command that leads to this result.	Set values within the specified range for parameters.
A.94D: Data setting warning (Data size error)	Incorrect parameter size specified in the command	Confirm the command that leads to this result.	Set the correct parameter size.
A.94F: Hardware parameter information anomaly	Hardware information checksum error	Confirm the command that leads to this result.	Return the unit to the factory or contact technical personnel.
A.95A: Command warning (Conditions not met)	Instruction conditions are not met	Confirm the command that leads to this result.	Do not transmit unsupported commands.
A.95D: Command warning (command interference)	Latch command transmission conditions not met.	Confirm the command that leads to this result.	Send the command only after the transmission conditions are satisfied.
A.971: Undervoltage	For 200V servo drive, AC power supply voltage at 140V or less; For 400V servo drive, AC supply voltage at 240V or less.	Measure power supply voltage.	Adjust the power supply voltage to the normal range.
	The power supply voltage drops during operation.	Measure power supply voltage.	Increase power supply capacity.
	A momentary power interruption occurs.	Measure power supply voltage.	If the setting of Pn509 (Momentary power interruption hold time) is modified, set it to a smaller value.
	The fuse of the servo drive is blown out.	—	Replace the servo drive and connect a reactor before reusing it.
	Servo drive failure	—	The servo drive may be faulty. Replace the servo drive.

A.9A0: Overtravel (Overtravel status detected)	Overtravel is detected when the servo is ON.	Check the status of the overtravel signals on the input signal monitor (Un005).	Fault causes and how to address them can be determined from the servo motor's operation and status. Additionally, if the overtravel signal cannot be confirmed via input signal monitoring (Un005), it may indicate that instantaneous overtravel has been detected. Take the following steps: · Do not send commands to the overtravel range from the host device. · Check the wiring for the overtravel signal. · Implement anti-interference measures.
A.9B0: Soft limit error	Soft limit setting error	Confirm that the value for 607D is set correctly.	Set the value of 607D within the correct range.
A.9B2: Synchronization frame loss	Synchronization frame data loss	Check whether shielded twisted-pair communication cables are being used; Confirm that the drive is properly grounded.	1. Use shielded twisted-pair cables with shielding functionality; 2. Follow standard wiring guidelines for connections; 3. After setting the pre-use synchronization cycle, switch the drive's EtherCAT communication state machine to operation mode; 4. If the master station's synchronization cycle itself has significant error, adjust the master station or increase the slave station's synchronization loss fault tolerance Pn785.
A.9B3: Bus interrupt	EtherCAT communication interruption	Check whether shielded twisted-pair communication cables are being used; Confirm that the drive is properly grounded.	1. Use shielded twisted-pair cables with shielding functionality; 2. Follow standard wiring guidelines for connections; 3. After setting the pre-use synchronization cycle, switch the drive's EtherCAT communication state machine to operation mode; 4. If the master station's synchronization cycle itself has significant error, adjust the master station or increase the slave station's synchronization loss fault tolerance Pn785.
A.9B4: Network initialization failure	EtherCAT network initialization is failed.	Unprogrammed device configuration file Servo drive failure	Program the corresponding XML file. Replace the servo drive.
A.9C0 Advanced auto-tuning warning 1	Operation status error	—	—

A.9C1 Advanced auto-tuning warning 2	When the tuning-free function is active, the rotational inertia estimation is not performed.	—	Set "Estimated Rotational Inertia [Default]" to restart tuning in HCServoWorks startup mode, or set [J. ON'] in the operation panel startup mode.
			Restart tuning, or disable the tuning-free function (Pn170.0=0).
A.9C2 Advanced auto-tuning warning 3	No positioning completion signal [COIN] is detected for over 10 seconds.	—	Increase the advanced auto-tuning initial gain level (Pn6B3) by one step. Or increase the advanced auto-tuning positioning accuracy (Pn6B5) by one step.
A.9C3 Advanced auto-tuning warning 4	The speed loop gain search reaches the lower limit.	—	Decrease the auto-tuning initial positioning accuracy (Pn6B5) by one step.
	Mechanical vibration occurs.		Vibration can be suppressed using the Type A Vibration Suppression Adjustment Function or the Vibration Suppression Function.
A.9C4 Advanced auto-tuning warning 5	Position loop or model loop gain search reaches the lower limit.	—	Increase the high-level auto-tuning positioning accuracy (Pn6B5) by one level. In HCServoWorks startup mode, set'Positioning Correspondence (Focus on Overshoot)' to restart tuning. Alternatively, in the operation panel startup mode, set 'L. 3' to restart tuning.
	Position complete signal (/COIN) is unstable during motor stop, cycling ON/OFF.		
	Mechanical vibration occurs.		Suppress vibration using the Type A vibration suppression adjustment function and vibration suppression function.
A.9C5 Advanced auto-tuning warning 6	Rotational inertia self-calibration has started but calibration processing has not been executed.	—	Increase the auto-tuning initial gain level (Pn6B3) by one step.
			Increase the movement distance.
A.9C6 Advanced auto-tuning warning 7	Rotational inertia self-calibration result deviation is excessive; deviation persists after 10 retries.	—	Current mechanical inertia cannot be estimated; manually set the rotational inertia ratio (Pn103) directly based on mechanical specifications.
			Set 'Do not estimate rotational inertia' in HCServoWorks startup mode to restart tuning, or set 'J. OFF' in the operation panel startup mode to restart tuning.
A.9C7 Advanced auto-tuning warning 8	Low-frequency vibration is detected during rotational inertia self-calibration.	—	Increase the advanced auto-tuning initial inertia level (Pn6B4) by one step.
A.9C8 Advanced auto-tuning warning 9	Torque limit value is reached.	—	Increase the torque limit value when a torque limit is set.
			Increase the initial inertia level for advanced auto-tuning (Pn6B4) by one step.

A.9C9 Advanced auto-tuning warning 10	During the automatic inertia estimation process, an external input (/ P-CON) causes the speed loop control mode to switch to P-control.	—	Switch to PI control during inertia auto-estimation.
A.9CA Advanced auto-tuning warning 11	An alarm or warning occurs in the servo during the tuning process.	—	Eliminate the cause of the alarm or warning and retry.
A.9CB Advanced auto-tuning warning 12	The servo's main power is not ready during the tuning process.	—	Turn on the main circuit power and retry.
A.9CC Advanced auto-tuning warning 13	The servo is in the overtravel state during the tuning process.	—	Eliminate the cause of the overtravel and retry.
A.9CD Advanced auto-tuning warning 14	The servo is not enabled during the tuning process.	—	Do not perform servo enable OFF operations during tuning operation.
A.9CE Advanced auto-tuning warning 15	The servo's active gain is not gain 1 during the tuning process.	—	Set automatic gain switching to disabled (Pn139.0=0) and G-SEL to OFF state.
A.9CF Advanced auto-tuning warning 16	The servo is in the STO state during the tuning process.	—	Release the STO state and retry.
A.9D0 Advanced auto-tuning warning 17	Before tuning, pole detection is not performed.	—	Perform pole detection first, then retry.
A.9D1 Advanced auto-tuning warning 18	During the tuning process, the maximum time limit is exceeded.	—	Check the mechanical connections, then retry.
A.9D2 Advanced auto-tuning warning 19	After tuning, the gain results fail to save.	—	Do not perform other parameter write operations during tuning, then retry.
A.9D3 Advanced auto-tuning warning 20	During the tuning process, the host downlink command times out.	—	Check the USB wiring or replace the USB cable, then retry.

10.3 Causes and troubleshooting based on the operation and conditions

This section provides troubleshooting based on the operation and conditions of the servo motor, including causes and corrections.

Table 10-6 Fault causes and troubleshooting

Fault content	Cause	Confirmation method	Correction
Servo motor start failure	Control power supply is not connected.	Measure the voltage between control power supply terminals.	Ensure correct wiring to turn on the control power supply.
	Main circuit power supply is not connected.	Measure the voltage between the main circuit power input terminals.	Ensure correct wiring to turn on the main circuit power supply.
	I/O terminals (CN1) have wiring errors and omissions.	Check the wiring condition of the I/O signal connector (CN1) pins.	Ensure correct wiring of the I/O terminals (CN1).
	Loose wiring or disconnection in the servo motor main circuit cable and encoder cable.	Check the wiring conditions.	Ensure correct wiring.
	Excessive load on the servo motor.	Operate the servo motor with no load and check the load status.	Reduce the load or replace with a higher-capacity servo motor.
	The type of encoder used differs from the setting of Pn002.2.	Check the type of the encoder that is being used and the setting of Pn002.2.	Set Pn002.2 based on the encoder in use.
	No input of speed/position command.	Check the allocation status of the input signals.	Assign input signals to ensure proper input of speed/position commands.
	Incorrect assignment of input signals (Pn590 ~ Pn5A4).	Check the input signal allocations (Pn590 ~ Pn5A4)	Ensure correct assignment of input signals (Pn590 ~ Pn5A4).
	The /S-ON input is OFF.	Check the setting of the input signals.	Set the input signals correctly to turn on the / S-ON input.
	The function setting for the /P-CON input is incorrect.	Check the setting of Pn000.1.	Set correctly based on the intended function.
	Incorrect speed command input (during speed control).	Between V-REF and SG, check if the control mode matches the input.	Set the control mode and input method correctly.
	Incorrect torque command input (during torque control).	Between V-REF and SG, check if the control mode matches the input.	Set the control mode and input method correctly.
	Incorrect command pulse input (during position control).	Check the command pulse shape and sign + pulse signal of Pn200.0.	Set the control mode and input method correctly.
	The position deviation clear (/CLR) input remains ON.	Check the /CLR input signal.	Turn off the /CLR input signal.
	The forward drive prohibition (P-OT) and reverse drive prohibition (N-OT) input signals remain OFF.	Check the P-OT or N-OT input signal.	Set the P-OT or N-OT input signal to ON.
	The safety input signals (/STO1 or / STO2) remain OFF.	Check the /STO1 and /STO2 input signals.	Set the /STO1 and /STO2 input signals to ON. When not using the safety function, install the included safety jumper plug into CN8.
	Servo drive failure	-	Replace the servo drive.
Momentary running and subsequent stop of the servo motor	Servo motor wiring error	Check the wiring.	Ensure correct wiring.
	Encoder wiring error	Check the wiring.	Ensure correct wiring.

Servo motor operational instability	Servo motor cable wiring defect	Power lines (U, V, W phases) and encoder plug connections may be unstable. Check the wiring.	Tighten any loose terminals or connectors and correct the wiring.
Servo motor rotation without command	Incorrect speed command input (during speed control).	Between V-REF and SG, check if the control mode matches the input.	Set the control mode and input method correctly.
	Incorrect torque command input (during torque control).	Between V-REF and SG, check if the control mode matches the input.	Set the control mode and input method correctly.
	Offset deviation in the speed command.	Improper offset adjustment of the servo drive.	Adjust the offset of the servo drive.
	Servo drive failure	-	Replace the servo drive.
Dynamic brake (DB) non-operation	The setting value of parameter Pn001.0 is incorrect.	Check the setting value of parameter Pn001.0.	Set Pn001.0 correctly.
	DB resistor is disconnected.	Check the moment of inertia, motor speed, and dynamic brake frequency of use. If the moment of inertia, motor speed, or dynamic brake frequency of use is excessive, the dynamic brake resistance may be disconnected.	Replace the servo drive. To prevent disconnection, reduce the load.
	There is a failure in the dynamic brake drive circuit.	-	There is a defective component in the dynamic brake circuit. Replace the servo drive .
	The servo motor vibrates significantly while using the tuning-less function (default setting).	Check the waveform of the motor speed.	Reduce the load so that it is below the allowable moment of inertia ratio, or increase the load value of the tuning-free value setting (Fn200), or reduce the rigidity value.
	The machine mounting is not secure.	Check the installation status of the servo motor	Tighten the mounting screws.
		Check to see if there is misalignment in the coupling.	Align the coupling.
		Check to see if the coupling is balanced.	Balance the coupling.
	Bearing internal fault	Check for noise and vibration around the bearings.	Replace the servo motor.
	Vibration originating from associated machinery	Check for any foreign matter, damage, or deformation in the machine's moving parts.	Consult with the machine manufacturer.
	Noise interference due to specification error in I/O signal cables.	Check if the I/O signal cables meet the specifications. Cable specifications: twisted pair shielded cable or twisted pair overall shielded cable (core wire: $0.12mm^2$ or thicker, tin-plated soft copper stranded wire).	Use cables meeting the specifications.
	Noise interference due to excessive length of I/O signal cables.	Check the length of the I/O signal cables.	Limit the length of I/O signal cables to 3m less.

Abnormal noise from servo motor	Noise interference due to specification error in encoder cables.	Check if the encoder cables meet the specifications. Cable specifications: twisted pair shielded cable or twisted pair overall shielded cable. (core wire: $0.12mm^2$ or thicker, tin-plated soft copper stranded wire)	Use cables meeting the specifications.
	Noise interference due to excessive length of encoder cables.	Check the length of the encoder cables.	Set the length of encoder cables to within 50m.
	Noise interference due to damage to encoder cables.	Check if the encoder cables are pinched or have jacket damage.	Replace encoder cables and alter their installation environment.
	Excessive noise interference on encoder cables.	Check if the encoder cables are bundled with high-current wires or too close to them.	Modify the laying environment of encoder cables to avoid surge voltage from high-current wires.
	Variation in FG potential due to servo motor-side equipment (e.g., welding machines).	Check the grounding status of servo motor-side equipment (missing grounding, incomplete grounding).	Properly ground servo motor-side equipment to prevent current diversion to the encoder-side FG.
	Pulse count error in the servo drive due to noise interference.	Check for noise interference between the encoder and signal lines.	Implement anti-interference measures for encoder wiring.
	The encoder is subjected to excessive vibration or shock.	Check to see if vibration from the machine occurs. Check the servo motor installation (mounting surface precision, securing state, and alignment).	Reduce mechanical vibration and improve the installation status of the servo motor.
	Encoder failure	-	Replace the servo motor.
Motor vibration at approximately 200-400hz	Servo gain balance is poor.	Check if servo gain tuning has been performed.	Perform advanced auto-tuning.
	The set value of speed loop gain (Pn100) is too high.	Check the speed loop gain (Pn100) set value (default value: Kv = 40.0Hz).	Set the correct speed loop gain (Pn100) set value.
	The set value of position loop gain (Pn102) is too high.	Check the position loop gain (Pn102) set value (default value: Kp = 40.0/s).	Set the correct position loop gain (Pn102) set value.
	The speed loop integral time constant (Pn101) is improperly set.	Check the factory default of speed loop integral time constant (Pn101) (Ti = 20.0ms).	Set the correct speed loop integral time constant (Pn101) set value.
	The inertia ratio (Pn103) set value is incorrect.	Check the inertia ratio (Pn103) set value.	Set the correct inertia ratio (Pn103) set value.
Excessive speed overshoot at start/ stop	Servo gain balance is poor.	Check if servo gain tuning has been performed.	Perform advanced auto-tuning.
	The set value of speed loop gain (Pn100) is too high.	Check the speed loop gain (Pn100) set value (default value: Kv = 40.0Hz).	Set the correct speed loop gain (Pn100) set value.
	The set value of position loop gain (Pn102) is too high.	Check the position loop gain (Pn102) set value (default value: Kp = 40.0/s).	Set the correct position loop gain (Pn102) set value.
	The speed loop integral time constant (Pn101) is improperly set.	Check the factory default of speed loop integral time constant (Pn101) (Ti = 20.0ms).	Set the correct speed loop integral time constant (Pn101) set value.
	The inertia ratio (Pn103) set value is incorrect.	Check the inertia ratio (Pn103) set value.	Set the correct inertia ratio (Pn103) set value.

Absolute encoder position deviation error (deviation between host-stored power-off position and re-power-on position)	Noise interference due to specification error in I/O signal cables.	Check if the I/O signal cables meet the specifications. Cable specifications: twisted pair shielded cable or twisted pair overall shielded cable (core wire: $0.12mm^2$ or thicker, tin-plated soft copper stranded wire).	Use cables meeting the specifications.
	Noise interference due to excessive length of I/O signal cables.	Check the length of the encoder cables.	Set the length of encoder cables to within 50m.
	Noise interference due to damage to encoder cables.	Check if the encoder cables are pinched or have jacket damage.	Replace encoder cables and alter their installation environment.
	Excessive noise interference on encoder cables.	Check if the encoder cables are bundled with high-current wires or too close to them.	Modify the laying environment of encoder cables to avoid surge voltage from high-current wires.
	Variation in FG potential due to servo motor-side equipment (e.g., welding machines).	Check the grounding status of the servo motor-side equipment (missing grounding, incomplete grounding).	Properly ground servo motor-side equipment to prevent current diversion to the encoder-side FG.
	Pulse count error in the servo drive due to noise interference.	Check for noise interference between the encoder and signal lines.	Implement anti-interference measures for encoder wiring.
	The encoder is subjected to excessive vibration or shock.	Check whether vibration from the machine occurs. Check the servo motor installation (mounting surface precision, securing state, and alignment).	Reduce mechanical vibration and improve the installation status of the servo motor.
	Encoder failure	-	Replace the servo motor.
	Servo drive failure (Pulses unchanged)	-	Replace the servo drive.
	Host device multi-rotation data read error	Check the error detection part of the host controller	Make the error detection unit of the host device work properly.
		Check to see if the host controller is executing data parity checks	Perform parity check on the multi-rotation data.
		Check for noise interference in the cable between the servo drive and the host controller	Take anti-interference measures and recheck the parity of the multi-rotation data.
Overtravel (OT)	The forward/reverse drive prohibition signal (P-OT/N-OT) is input.	Check the voltage of the external +24V power supply for input signals.	Set the voltage of the external +24V power supply for input signals to the correct value.
		Check the operating status of the overtravel limit switch.	Ensure the overtravel limit switch operates normally.
		Check the wiring of the overtravel limit switch.	Ensure correct wiring of the overtravel limit switch.
		Check the set value of the parameter.	Set the parameter correctly.
	The forward/reverse drive prohibition signal (P-OT/N-OT) malfunctions.	Check for voltage fluctuations in the external +24V power supply for input signals.	Eliminate voltage fluctuations in the external +24V power supply for input signals.
		Check if the operating status of the overtravel limit switch is unstable.	Stabilize the operating status of the overtravel limit switch.
		Check the wiring of the overtravel limit switch (e.g., cable damage, screw tightness).	Ensure correct wiring of the overtravel limit switch.

	Error in parameter assignment for the forward/reverse drive prohibition signal (P-OT/N-OT).	Confirm the P-OT signal is correctly assigned.	If other signals have been assigned to the set parameter,reassign the P-OT signal to that parameter.
		Confirm the N-OT signal is assigned to the correct location.	If other signals have been assigned to the set parameter,reassign the N-OT signal to that parameter.
	Incorrect selection of the servo motor stop method.	Confirm Pn001.0 and Pn001.1 when the servo is OFF.	Select a servo motor stop method other than coast to stop.
		Confirm Pn001.0 and Pn001.1 during torque control.	Select a servo motor stop method other than coast to stop.
Stop position inaccuracy due to overtravel (OT)	The position of the limit switch and the length of the monitoring device are improper.	-	Set the limit switch to an appropriate position.
	The position of the overtravel limit switch is shorter than the inertia run-out.	-	Install the overtravel limit switch in an appropriate position.
Position deviation (no alarm)	Noise interference due to specification error in I/O signal cables.	Check if the I/O signal cables meet the specifications. Cable specifications: twisted pair shielded cable or twisted pair overall shielded cable (core wire: 0.12mm² or thicker, tin-plated soft copper stranded wire).	Use cables meeting the specifications.
	Noise interference due to excessive length of I/O signal cables.	Check the length of the encoder cables.	Set the length of encoder cables to within 50m.
	Noise interference due to damage to encoder cables.	Check if the encoder cables are pinched or have jacket damage.	Replace encoder cables and alter their installation environment.
	Excessive noise interference on encoder cables.	Check if the encoder cables are bundled with high-current wires or too close to them.	Modify the laying environment of encoder cables to avoid surge voltage from high-current wires.
	Variation in FG potential due to servo motor-side equipment (e.g., welding machines).	Check the grounding status of the servo motor-side equipment (missing grounding, incomplete grounding).	Properly ground servo motor-side equipment to prevent current diversion to the encoder-side FG.
	Pulse count error in the servo drive due to noise interference.	Check for noise interference between the encoder and signal lines.	Implement anti-interference measures for encoder wiring. ,
	The encoder is subjected to excessive vibration or shock.	Check whether vibration from the machine occurs. Check the servo motor installation (mounting surface precision, securing state, and alignment).	Reduce mechanical vibration and improve the installation status of the servo motor.
	Coupling fault between the machine and the servo motor.	Check the coupling part between the machine and the servo motor for misalignment.	Correctly fix the coupling between the machine and the servo motor.
	Noise interference due to specification error in I/O signal cables.	Check if the I/O signal cables meet the specifications. Cable specifications: twisted pair shielded cable or twisted pair overall shielded cable (core wire: 0.12mm² or thicker, tin-plated soft copper stranded wire) .	Use cables that meet the specifications.

	When using the instruction pulse input multiplier switching function, input/output signals for this function (/PSEL, /PSELA) are incorrectly detected due to interference.	Check if the I/O signal cables meet the specifications. Cable specifications: twisted pair shielded cable or twisted pair overall shielded cable (core wire: $0.12mm^2$ or thicker, tin-plated soft copper stranded wire) .	Use cables that meet the specifications.
	Noise interference due to excessive length of I/O signal cables.	Check the length of the I/O signal cables.	Limit the length of I/O signal cables to 3m or less.
	Encoder failure (Pulses unchanged)	-	Replace the servo drive.
	Servo drive failure	-	Replace the servo drive.
Servo motor overheating	Ambient temperature is too high.	Measure the ambient temperature of the servo motor.	Keep ambient temperature below 40℃ .
	Servo motor surface is dirty.	Visually inspect dirt on the servo motor surface.	Remove dirt, dust, oil, etc., from the servo motor surface.
	Servo motor is overloaded.	Check the load status with a monitor.	If overloaded, reduce the load or replace with a higher-capacity servo drive and servo motor.

Chapter 11 Parameter List

11.1 Auxiliary Function List

Table 11-1 Auxiliary function list

Fn No.	Function	By operation panel	By HCServoWorks	Reference chapter
Fn000	Display Alarm History	1	1	8.2
Fn001	Simple Rigidity Selection	1	1	8.3
Fn002	Run JOG	1	1	8.4
Fn003	Origin search	1	1	8.5
Fn004	Run JOG Program	1	1	8.6
Fn005	Initialize Parameters	1	1	8.7
Fn006	Clear Alarm History	1	1	8.8
Fn008	Reset Absolute Encoder (initialization) and Reset Encoder Alarm	1	1	8.9
Fn00E	Auto Tuning Motor Current Detection Signal Offset	1	1	8.10
Fn00F	Manually Adjust Motor Current Detection Signal Offset	1	1	8.11
Fn010	Write Prohibition Setting	1	0	8.12
Fn011	Display Servomotor Model	1	1	8.13
Fn012	Display Software Version	1	1	8.14
Fn01B	Initialize Vibration Detection Value	1	1	8.15
Fn030	Software Reset	1	1	8.16
Fn080	Magnetic pole detection	1	1	8.17
Fn082	Current JOG	1	1	8.18
Fn200	Set Auto-tuning Level	1	1	8.19
Fn201	Advanced Auto-tuning without Reference	1	1	8.20
Fn202	Advanced Auto-tuning with Reference	1	1	8.21
Fn203	Single-Parameter Tuning	1	1	8.22
Fn204	Type A vibration suppression control function	0	1	—
Fn205	MFC vibration detection	0	1	—
Fn206	EasyFFT	1	1	8.23
Fn207	Auto-vibration detection	1	1	8.24

1 : Operable 0 :Not operable

Note: When performing auxiliary functions, be sure to use the operation panel or HCServoWorks. If an auxiliary function be performed at the same time, "no_oP" or "NO-OP" will be displayed.

11.2 Parameter List

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn000 (2000h)	Basic Function Selection 0	0000H - 0001H	—	0000H	After restart	Setup	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Rotation Direction Selection	Reference
0	Take CCW direction as the forward rotation direction.	—
1	Take CW direction as the forward rotation direction. (Reverse Mode)	

Bit 1, Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn001 (2001h)	Application Function Selection 1	0000H~0166H	—	0036H	After restart	Setup	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Stopping Method at Servo OFF	Reference
0	Stop the motor by applying the dynamic brake	—
1	Stop by applying dynamic brake and then release the dynamic brake	
2	Coast the motor to a stop without the dynamic brake	
3	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, and enter the DB control state after stop	
4	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, terminate the motor through DB, and then release DB	
5	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the DB control state after stop	
6	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the free control state after stop	

Bit 1:

	Overtravel Stopping Method	Reference
0	Stop the motor by applying the dynamic brake	—
1	Stop by applying dynamic brake and then release the dynamic brake	
2	Coast the motor to a stop without the dynamic brake	
3	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, and enter the servo lock state after stop	
4	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, and enter the free control state after stop	
5	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the servo lock state after stop	
6	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the free control state after stop	

Bit 2:

	Main Circuit Power Supply AC/DC Input Selection	Reference
0	AC power input: From L1, L2, (L3) terminals	—
1	DC power input: From B1/(+)! (-), from B1/(+)! (-) or from P/(+)!	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn002 (2002h)	Application Function Selection 2	0000H~0211H	—	0111H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0: Reserved parameter (Do not change.)

Bit 1: Reserved parameter (Do not change.)

Bit 2:

	Usage of encoder	Reference
0	Use encoder as the absolute encoder	—
1	Use encoder as incremental encoder	
2	Use encoder as single-turn absolute encoder (rotating)	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn008 (2008h)	Application Function Selection 8	0000H - 4121H	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Battery undervoltage alarm/warning selection	Reference
0	Set battery undervoltage to alarm (A.830)	—
1	Set battery undervoltage to warning (A.930)	

Bit 1:

	Main circuit undervoltage function selection	Reference
0	Do not detect main circuit undervoltage warning	—
1	Detect undervoltage warning of main circuit and implement torque limit at host controller	
2	Detect undervoltage warning of main circuit and limit torque with Pn424 and Pn425 (only in servo drive).	

Bit 2:

	Warning detection selection	Reference
0	Detect warnings.	—
1	Do not detect warnings (except A.971)	

Bit 3:

	Alarm detection selection	Reference
0	Not used	—
1	Do not detect position bias warning when servo ON (A.901)	
2	Do not vibration warning detected (A.911)	
4	Do not detect Pn change warning requiring re-energization (A.941)	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn009 (2009h)	Application Function Selection 9	0000H - 0130H	—	0010H	After restart	Tuning	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0: Reserved parameter (Do not change.)

Bit 1:

	Current control mode selection	Reference
0	Select current control mode 1.	—
1	Select current control mode 2.	
2	Select current control mode 3.	
3	Select current control mode 4.	

Bit 2:

	Velocity detection mode selection	Reference
0	Select velocity detection mode 1 (without speed smoothing filter)	—
1	Select velocity detection mode 2 (with speed smoothing filter)	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn00A	Application Function SelectionA	0000H - 0062H	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Motor Stopping Method for BM.1 alarm	Reference
0	Motor stop via DB (dynamic brake)	—
1	Motor stop via DB and then release the DB	
2	Set the motor to the free-running state without DB.	

Bit 1:

	Motor Stopping method for forced stop	Reference
0	Stop the motor by applying the dynamic brake	—
1	Stop by applying dynamic brake and then release the dynamic brake	
2	Coast the motor to a stop without the dynamic brake	
3	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, and enter the DB control state after stop	
4	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, terminate the motor through DB, and then release DB	
5	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the DB control state after stop	
6	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the free control state after stop	

Bit 2: Reserved parameter (Do not change.)

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn00B (200Bh)	Application Function SelectionB	0000H - 0161H	—	0031H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Operator Pn display selection	Reference
0	Display only parameters for setting	—
1	Display all parameters.	

Bit 1:

	Motor Stopping Method for BM.2 alarm	Reference
0	Stop the motor by applying the dynamic brake	—
1	Stop by applying dynamic brake and then release the dynamic brake	
2	Coast the motor to a stop without the dynamic brake	
3	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, and enter the DB control state after stop	
4	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque, terminate the motor through DB, and then release DB	
5	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the DB control state after stop	
6	Decelerate the motor to a stop using the deceleration time set in Pn30A, and enter the free control state after stop	

Bit 2:

	Power input selection of servo unit with three-phase input specification (set servo power under 220V 1KW to value 1)	Reference
0	Three-phase power input.	—
1	single-phase power input. (Use three-phase input specifications)	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn00C (200Ch)	Application Function SelectionC	0000H - 0131H	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	No motor test function selection	Reference
0	Set test mode without motor to invalid	—
1	Set test mode without motor to valid	

Bit 1:

	Encoder Resolution for Tests without a Motor	Reference
0	17 bit	—
1	20 bit	
2	23 bit	
3	25 bit	

Bit 2:

	Encoder Type Selection for Tests without a Motor	Reference
0	Use an incremental encoder.	—
1	Use an absolute encoder	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn00D (200Dh)	Application Function SelectionD	0000H~1100H	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0: Reserved parameter (Do not change.)

Bit 1: Reserved parameter (Do not change.)

Bit 2:

	Hardware limit signal detection limit selection	Reference
0	N/A	—
1	Detect only when enabled	

Bit 3:

	Over Travel (OT) Warning Detect Selection	Reference
0	Over travel warning not detected	—
1	Over travel warning detected	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn080 (2080h)	Application Function Selection 80	0000H -0101H	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Pole sensor selection	Reference
0	With	—
1	Without	

Bit 1: Reserved parameter (Do not change.)

Bit 2:

	Setting Velocity and frequency division calculation Selection	Reference
0	Calculate the division output setting at the fixed maximum speed	—
1	Calculate the maximum speed at the fixed frequency division output setting	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn100 (2100h)	Velocity loop gain	10 ~ 20000	0.1Hz	400	Immediately	Tuning	—
Pn101 (2101h)	Integral time constant of velocity loop	15 ~ 51200	0.01ms	2000	Immediately	Tuning	—
Pn102 (2102h)	Position loop gain	10 ~ 20000	0.1Hz	400	Immediately	Tuning	—
Pn103 (2103h)	Moment of inertia ratio	0 ~ 20000	1%	100	Immediately	Tuning	—
Pn104 (2104h)	Second Velocity loop gain	10 ~ 20000	0.1Hz	400	Immediately	Tuning	—
Pn105 (2105h)	Integral time constant of second speed loop	15 ~ 51200	0.01ms	2000	Immediately	Tuning	—
Pn106 (2106h)	Second position loop gain	10 ~ 20000	0.1Hz	400	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn107 (2107h)	Pseudo differential feed forward control coefficient	0 ~ 2000	0.1%	0	Immediately	Tuning	—
Pn109 (2109h)	Velocity Feedforward	0 ~ 100	1%	0	Immediately	Tuning	—
Pn10A (210Ah)	Feedforward filter time constant	0 ~ 6400	0.01ms	0	Immediately	Tuning	—
Pn10B (210Bh)	Gain type application function Selection	0000H - 0035H	—	0000H	After restart	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

	Mode selection	Reference
0	Based on internal torque command (value set Pn10C)	—
1	Based on velocity command (value setting: Pn10D)	
2	Based on acceleration (value setting: Pn10E)	
3	Based on position bias pulse (value setting: Pn10F)	
4	No mode selected	
5	Conditional on the speed loop integral set value (when speed loop integral = 51200).	

	Speed loop control mode	Reference
0	PI control	—
1	I-P control	
2	Reserved parameter (Do not change.)	
3	Reserved parameter (Do not change.)	

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn10C (210Ch)	Mode switch (torque command)	0 ~ 800	1%	200	Immediately	Tuning	—
Pn10D (210Dh)	Mode switch (velocity command)	0 ~ 10000	rpm	0	Immediately	Tuning	—
Pn10E (210Eh)	Mode switch (acceleration)	0 ~ 30000	rpm/s	0	Immediately	Tuning	—
Pn10F (210Fh)	Mode switch (position bias)	0 ~ 10000	1 Unit	0	Immediately	Tuning	—
Pn119 (2119h)	Torque feedforward	0~1000	1%	0	Immediately	Tuning	—
Pn11A (211Ah)	Feedforward filter time constant	0 ~ 6400	0.01ms	0	Immediately	Tuning	—
Pn11F (211Fh)	Position integral time constant	0 ~ 50000	0.1ms	0	Immediately	Tuning	—
Pn121 (2121h)	Friction compensation gain	10 ~ 1000	1%	100	Immediately	Tuning	—
Pn122 (2122h)	Second friction compensation gain	10 ~ 1000	1%	100	Immediately	Tuning	—
Pn123 (2123h)	Friction compensation coefficient	0 ~ 100	1%	0	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn124 (2124h)	Friction compensation frequency compensation	-10000 ~ 10000	0.1Hz	0	Immediately	Tuning	—
Pn125 (2125h)	Friction compensation gain compensation	1 ~ 1000	1%	100	Immediately	Tuning	—
Pn127 (2127h)	Velocity Observer Gain	1 ~ 500	1Hz	40	Immediately	Tuning	—
Pn128 (2128h)	Velocity Observer Position Compensation Gain	0 ~ 1000	1%	150	Immediately	Tuning	—
Pn131 (2131h)	Gain switching time 1	0 ~ 65535	1ms	0	Immediately	Tuning	—
Pn132 (2132h)	Gain switching time 2	0 ~ 65535	1ms	0	Immediately	Tuning	—
Pn135 (2135h)	Gain switching waiting time 1	0 ~ 65535	1ms	0	Immediately	Tuning	—
Pn136 (2136h)	Gain switching waiting time 2	0 ~ 65535	1ms	0	Immediately	Tuning	—
Pn137 (2137h)	Gain switching level 1	0 ~ 20000	-	0	Immediately	Tuning	—
Pn138 (2138h)	Gain switching level 2	0 ~ 20000	-	0	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn139 (2139h)	Automatic gain switch 1	0000H - 00A2H	—	0000H	Immediately	Tuning	—

n. □□□□ (Bit 3, Bit 2, Bit 1, Bit 0)

Bit 0:

	Gain switching selection	Reference
0	Use manual gain switching——By external input signal (/G-SEL)	—
1	Reserved parameter (Do not change.).	
2	Automatic gain switching pattern 1 The gain settings 1 switch automatically to 2 when switching condition A is satisfied. The gain settings 2 switch automatically to 1 when switching condition A is not satisfied.	

Bit 1:

	Gain Switching Condition A	Reference
0	Positioning completion signal (/COIN) ON.	—
1	Positioning completion signal (/COIN) OFF.	
2	Positioning proximity signal (/NEAR) ON.	
3	Positioning proximity signal (/NEAR) OFF.	
4	Position command filter output=0 and command pulse input OFF.	
5	Position command pulse input ON.	
6	Use internal torque [%] command as condition (value setting: Pn137, PN138)	
7	Use velocity command [rpm] as condition (value setting: Pn137, PN138)	
8	Use acceleration [rpm] as condition (value setting: Pn137, PN138)	
9	Use position bias pulse [command unit] as condition (value setting: Pn137, PN138)	
A	Use position command + actual speed [rpm] (value setting: PN138)	

Bit 2: Reserved parameter (Do not change.)

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn13D (213Dh)	Current gain value	100 ~ 2000	1%	2000	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn140 (2140h)	Model tracking control selection	0000H - 1121H	—	0100H	Immediately	Tuning	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

Model Tracking Control Selection		Reference
0	Do not use model tracking control	—
1	Use model tracking control	

Bit 1:

Vibration suppression selection		Reference
0	No vibration suppression.	—
1	An additional vibration suppression function for a specific frequency.	
2	Vibration suppression is added for 2 different frequencies.	

Bit 2:

Vibration suppression function adjustment selection		Reference
0	The vibration suppression function is not automatically adjusted by the auxiliary function.	—
1	The vibration suppression function is automatically adjusted by auxiliary functions.	

Bit 3:

Velocity Feedforward (VFF)/Torque Feedforward (TFF)Selection		Reference
0	Model tracking control and velocity/torque feedforward are not used simulta-neously.	—
1	Both model tracking control and speed/torque feedforward are used.	

Pn141 (2141h)	Model Tracking Control Gain	10 ~ 20000	0.1Hz	500	Immediately	Tuning	—
Pn142 (2142h)	Model Tracking Control Gain Compensation	500 ~ 2000	0.1%	1000	Immediately	Tuning	—
Pn143 (2142h)	Model Tracking Control Offset (forward direction)	0 ~ 10000	0.1%	1000	Immediately	Tuning	—
Pn144 (2144h)	Model Tracking Control Offset (Reverse Direction)	0 ~ 10000	0.1%	1000	Immediately	Tuning	—
Pn145 (2145h)	Vibration suppression 1 frequency A	10 ~ 2500	0.1Hz	500	Immediately	Tuning	—
Pn146 (2146h)	Vibration suppression 1 frequency B	10 ~ 2500	0.1Hz	700	Immediately	Tuning	—
Pn147 (2147h)	Model tracking control velocity feedforward compensation	0 ~ 10000	0.1%	1000	Immediately	Tuning	—
Pn148 (2148h)	The Second Model Tracking Control Gain	10 ~ 20000	0.1Hz	500	Immediately	Tuning	—
Pn149 (2149h)	The Second Model Tracking Control Gain Compensation	500 ~ 2000	0.1%	1000	Immediately	Tuning	—
Pn14A (214Ah)	Vibration suppression 2 frequency	10 ~ 2000	0.1Hz	800	Immediately	Tuning	—
Pn14B (214Bh)	Vibration suppression 2 compensation	10 ~ 1000	1%	100	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn14F (214Fh)	Control type Selections	0000H - 0021H	—	0011H	After restart	Tuning	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Model Tracking Control Type Selection	Reference
0	Select Model Tracking Control Type 1.	—
1	Select Model Tracking Control Type 2.	

Bit 1:

	Tuning-less Type Selection	Reference
0	Select tuning-less type 1	—
1	Select tuning-less type 2	
2	Select tuning-less type 3	

Bit 2: Reserved parameter (Do not change.)

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn160 (2160h)	Vibration suppression control type selection	0000H - 0011H	—	0010H	Immediately	Tuning	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Type A vibration suppression control selection	Reference
0	Do not use type A vibration suppression control.	—
1	Use type A vibration suppression control.	

Bit 1:

	Type A vibration suppression control tuning selection	Reference
0	Type A vibration suppression control is not auto-tuned by auxiliary functions.	—
1	The type A vibration suppression control is auto-tuned by auxiliary functions.	

Bit 2: Reserved parameter (Do not change.)

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn161 (2161h)	Type A vibration suppression frequency	10 ~ 20000	0.1Hz	1000	Immediately	Tuning	—
Pn162 (2162h)	Type A vibration suppression gain compensation	1 ~ 1000	1%	100	Immediately	Tuning	—
Pn163 (2163h)	Type A vibration damping gain	0 ~ 300	1%	0	Immediately	Tuning	—
Pn164 (2164h)	Type A vibration suppression filter time constant 1 compensation	-1000 ~ 1000	0.01ms	0	Immediately	Tuning	—
Pn165 (2165h)	Type A vibration suppression filter time constant 2 compensation	-1000 ~ 1000	0.01ms	0	Immediately	Tuning	—
Pn166 (2166h)	A-type vibration suppression attenuation gain 2	0 ~ 1000	1%	0	Immediately	Tuning	—
Pn167 (2167h)	Cut-off frequency of Type A damped high-pass filter	10 ~ 50000	0.1Hz	20000	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn170 (2170h)	Tuning-less type selections	0000H - 2711H	—	1400H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Tuning-less Selection	Reference
0	Disable tuning-less function	—
1	Enable tuning-less function	

Bit 1:

	Control mode for velocity control	Reference
0	Use as velocity control	—
1	Use as velocity control and the upper device is used as position control.	

Bit 2:

	Tuning-less Value	Reference
0 ~ 7	Set tuning-less value	—

Bit 3:

	Tuning-less Load Value	Reference
0 ~ 2	Set tuning-less value	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn207 (2207h)	Position control function switch	0000H~2000H	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0: Reserved parameter (Do not change.)

Bit 1: Reserved parameter (Do not change.)

Bit 2: Reserved parameter (Do not change.)

Bit 3:

	COIN (Positioning Completion Output)) signal output timing	Reference
0	Output when the absolute value of position bias is less than the width of positioning completion (Pn522)	—
1	Output when the absolute value of position bias is less than the width of position completion (Pn522) and the filtered position command is 0	
2	Output when the absolute value of position bias is less than the positioning completion width (Pn522) and the position command input is 0	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn216 (2216h)	Position command acceleration/deceleration time parameter	0 ~ 65535	0.1ms	0	Immediately	Basic setting	—
Pn217 (2217h)	Average time of position command movement	0 ~ 10000	0.1ms	0	Immediately	Basic setting	—
Pn219 (2219h)	Position command 2nd order low-pass filter cutoff frequency	0 ~ 10000	0.1Hz	0	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn230 (2230h)	Position control extended function switch	0000H - 0001H	—	0000H	After restart	Basic setting	—
	n. Bit 3 Bit 2 Bit 1 Bit 0 Bit 0: Mechanical backlash compensation direction (Reference: —) 0: Non-mechanical backlash compensation by commands in the positive direction 1: Non-mechanical backlash compensation by reverse direction command Bit 1: Reserved parameter (Do not change.) Bit 2: Reserved parameter (Do not change.) Bit 3: Reserved parameter (Do not change.)						
Pn231 (2231h)	Backlash compensation value	-500000-500000	0.1 Unit	0	Immediately	Basic setting	—
Pn233 (2233h)	Time parameter of backlash compensation	0 ~ 65535	0.01ms	0	Immediately	Basic setting	—
Pn260 (2260h)	Low-frequency vibration suppression mode selection	0~1	—	0	Immediately	Basic setting	—
	n. Bit 3 Bit 2 Bit 1 Bit 0 Bit 0: Bit0=0: Set parameters manually Bit0=1: Set parameters automatically Bit 1, Bit 2, Bit 3: Reserved parameter (Do not change.)						
Pn261 (2261h)	Low-frequency resonance frequency A	0 ~ 5000	0.1Hz	0	Immediately	Basic setting	—
Pn262 (2262h)	Suppression width of low-frequency resonance frequency A	0 ~ 10	—	2	Immediately	Basic setting	—
Pn263 (2263h)	Suppression depth of low-frequency resonance frequency A	0~1000	—	5	Immediately	Basic setting	—
Pn290 (2290h)	Enable cutting vibration	0000-0001	—	0000H	Immediately	Basic setting	—
Pn291 (2291h)	Maximum limit of cutting vibration	0 ~ 300	0.1%rev	100	Immediately	Basic setting	—
Pn292 (2292h)	Cutting vibration amplitude	0 ~ 32767	Unit	0	Immediately	Basic setting	—
Pn293 (2293h)	Cutting vibration frequency	10 ~ 500	0.1Hz	100	Immediately	Basic setting	—
Pn304 (2304h)	JOG Velocity	0 ~ 1000000	0.01rpm	50000	Immediately	Basic setting	—
Pn305 (2305h)	Soft start acceleration time	0~65535	1ms	0	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn306 (2306h)	Soft start deceleration time	0~65535	1ms	0	Immediately	Basic setting	—
Pn307 (2307h)	Velocity command filter time parameter	0 ~ 65535	0.01ms	0	Immediately	Basic setting	—
Pn308 (2308h)	Velocity Feedback Filter Time Parameters	0 ~ 65535	0.01ms	0	Immediately	Basic setting	—
Pn30A (230Ah)	Shutdown deceleration time	0 ~ 10000	ms	100	Immediately	Basic setting	—
Pn30C (230Ch)	Moving average time of velocity feedforward	0 ~ 5100	0.1ms	0	Immediately	Basic setting	—
Pn310 (2310h)	Vibration Detection Selection	0000H - 0002H	—	0000H	Immediately	Basic setting	—

Pn310 (2310h):

n. □ □ □ □ (Bit 3, Bit 2, Bit 1, Bit 0)

Bit 0:

	Vibration Detection Selection	Reference
0	Do not detect vibration.	—
1	Warns when vibration is detected (A.911).	
2	Alarm when vibration is detected (A.520).	

Bit 1: Reserved parameter (Do not change.)

Bit 2: Reserved parameter (Do not change.)

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn311 (2311h)	Vibration detection sensitivity	50 ~ 500	1%	100	Immediately	Tuning	—
Pn312 (2312h)	Vibration detection value	0 ~ 5000	rpm	50	Immediately	Tuning	—
Pn316 (2316h)	Motor Maximum Velocity Limit	0 ~ 65535	rpm	10000	After restart	Basic setting	—
Pn324 (2324h)	Starting value of moment of inertia calculation	0 ~ 20000	1%	300	Immediately	Basic setting	—
Pn325 (2325h)	Vibration Detection Level in Moment of Inertia Identification	0 ~ 5000	rpm	250	Immediately	Basic setting	—
Pn401 (2401h)	The first Segment 1st Torque Command Filter Time Constant	0 ~ 65535	0.01ms	100	Immediately	Tuning	—
Pn402 (2402h)	Forward torque limit	0 ~ 800	1%	800	Immediately	Basic setting	—
Pn403 (2403h)	Reverse torque limit	0 ~ 800	1%	800	Immediately	Basic setting	—
Pn404 (2404h)	Forward rotating external torque limit	0 ~ 800	1%	100	Immediately	Basic setting	—
Pn405 (2405h)	Reverse rotating external torque limit	0 ~ 800	1%	100	Immediately	Basic setting	—
Pn406 (2406h)	Emergency stop torque	0 ~ 800	1%	800	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn407 (2407h)	Velocity limit at torque control	0 ~ 10000	rpm	10000	Immediately	Basic setting	—
Pn408 (2408h)	Torque type function selection	0000H~1111H	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

Notch filter selection 1		Reference
0	Disable the first segment notch filter.	—
1	Enable the first segment notch filter.	

Bit 1:

Velocity limit selection		Reference
0	Set the smaller of the maximum motor velocity or Pn407 setpoint as the velocity limit.	—
1	Set the smaller of the over velocity alarm detection velocity or Pn407 setpoint as the velocity limit.	

Bit 2:

Notch filter selection 2		Reference
0	Disable the second segment notch filter..	—
1	Enable the second segment notch filter..	

Bit 3:

Friction compensation function selection		Reference
0	Disable friction compensation.	—
1	Enable friction compensation.	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn409 (2409h)	The first segment notch filter frequency	50 ~ 5000	1Hz	5000	Immediately	Tuning	—
Pn40A (240Ah)	Q value of the first segment notch filter	50 ~ 1000	0.01	70	Immediately	Tuning	—
Pn40B (240Bh)	Notch depth of the first segment notch filter	0 ~ 1000	0.001	0	Immediately	Tuning	—
Pn40C (240Ch)	The second segment notch filter frequency	50 ~ 5000	1Hz	5000	Immediately	Tuning	—
Pn40D (240Dh)	Q value of the second segment notch filter	50 ~ 1000	0.01	70	Immediately	Tuning	—
Pn40E (240Eh)	Notch depth of the second segment notch filter	0 ~ 1000	0.001	0	Immediately	Tuning	—
Pn40F (240Fh)	The second Segment 2nd Torque Command Filter Frequency	100 ~ 5000	1Hz	5000	Immediately	Tuning	—
Pn410 (2410h)	Q value of the second segment torque command filter	50 ~ 100	0.01	50	Immediately	Tuning	—
Pn412 (2412h)	The first Segment 2nd Torque Command Filter Time Constant	0 ~ 65535	0.01ms	100	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn416 (2416h)	Torque type function selection 2	0000H - 0111H	—	0000H	Immediately	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Notch filter selection 3	Reference
0	Disable the third segment notch filter.	—
1	Enable the third segment notch filter.	

Bit 1:

	Notch filter selection 4	Reference
0	Disable the fourth segment notch filter.	—
1	Enable the fourth segment notch filter.	

Bit 2:

	Notch filter selection 5	Reference
0	Disable the fifth segment notch filter.	—
1	Enable the fifth segment notch filter.	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn417 (2417h)	The third segment notch filter frequency	50 ~ 5000	Hz	5000	Immediately	Tuning	—
Pn418 (2418h)	Q value of the third segment notch filter	50 ~ 1000	0.01	70	Immediately	Tuning	—
Pn419 (2419h)	The third segment notch filter depth	0 ~ 1000	0.001	0	Immediately	Tuning	—
Pn41A (241Ah)	The fourth segment notch filter frequency	50 ~ 5000	Hz	5000	Immediately	Tuning	—
Pn41B (241Bh)	Q value of the fourth segment notch filter	50 ~ 1000	0.01	70	Immediately	Tuning	—
Pn41C (241Ch)	The fourth segment notch filter depth	0 ~ 1000	0.001	0	Immediately	Tuning	—
Pn41D (241Dh)	The fifth segment notch filter frequency	50 ~ 5000	Hz	5000	Immediately	Tuning	—
Pn41E (241Eh)	Q value of the fifth segment notch filter	50 ~ 1000	0.01	70	Immediately	Tuning	—
Pn41F (241Fh)	The fifth segment notch filter depth	0 ~ 1000	0.001	0	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn423 (2423h)	Velocity ripple compensation switch (rotary)	0000H - 1111H	—	0000H	Immediately	—	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 0:

Velocity ripple compensation Selection		Reference
0	Disable velocity ripple compensation function	—
1	Enable velocity ripple compensation function	

Bit 1:

Alarm detection for inconsistent velocity pulse compensation information Selection		Reference
0	Detected A.942	—
1	Do not detect A.942	

Bit 2:

Effective Conditions for Velocity Pulse Compensation Selection		Reference
0	Velocity command	—
1	motor velocity	

Bit 3:

compensation angle selection		Reference
0	Mechanical angle	—
1	Electrical angle	

Pn424 (2424h)	Torque limit when main circuit voltage drops	0 ~ 100	1%	50	Immediately	Basic setting	—
Pn425 (2425h)	Torque limit release time when main circuit voltage drops	0 ~ 1000	1ms	100	Immediately	Basic setting	—
Pn426 (2426h)	Shifting average time of torque feedforward	0 ~ 5100	0.1ms	0	Immediately	Basic setting	—
Pn427 (2427h)	Velocity ripple compensation effective velocity (rotation)	0 ~ 10000	rpm	0	Immediately	Basic setting	—
Pn453 (2453h)	Scan start frequency	1 ~ 5000	Hz	400	Immediately	Basic setting	—
Pn454 (2454h)	Scan End Frequency	50 ~ 5000	Hz	4000	Immediately	Basic setting	—
Pn455 (2455h)	Detection of lower limit of resonance frequency	50 ~ 5000	Hz	500	Immediately	Basic setting	—
Pn456 (2456h)	Sweep torque command amplitude	1 ~ 800	1%	15	Immediately	Tuning	—
Pn457 (2457h)	FFT related function switch	0000H - 2742H	—	0210H	After restart	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn460 (2460h)	Notch filter adjustment switch	0000H - 0101H	—	0101H	Immediately	Tuning	—

n.□□□□ (Bit 3, Bit 2, Bit 1, Bit 0)

Bit 0:

	Notch filter tuning selection 1	Reference
0	The first segment notch filter is not auto-tuning by the auxiliary function.	—
1	The first segment notch filter auto-tuned by the auxiliary function.	

Bit 1: Reserved parameter (Do not change.)

Bit 2:

	Notch filter tuning selection 2	Reference
0	The second segment notch filter is not auto-tuning by the auxiliary function.	—
1	The second segment notch filter auto-tuned by the auxiliary function.	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn466 (2466h)	Adaptive notch filter mode selection	0000H - 0007H	—	0004H	Immediately	Basic setting	—

n.□□□□ (Bit 3, Bit 2, Bit 1, Bit 0)

Bit 0:

	Self-adaption limiter mode selection	Reference
0	DO not update the adaptive filter.	—
1	One group of adaptive filters is active (The 3rd group notch filter)	
2	Two groups of adaptive filters are active (The 3rd and 4th group notch filters)	
3	Only test resonance point (Pn417/Pn41A)	
4	Clear the adaptive notch and restore the values of the 3rd and 4th group notch to the factory state	
5	Type A vibration suppression is effective (Pn672/Pn675)	
6	Type A vibration suppression and the 3rd and 4th group adaptive filters are effective	
7	Type A vibration suppression and the 3rd and 4th group adaptive filters are invalid and return to the factory state	

Bit 1, Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn471 (2471h)	Forward Coulomb friction compensation torque	0 ~ 1000	0.1%	0	Immediately	Basic setting	—
Pn472 (2472h)	Negative Coulomb friction compensation torque	0 ~ 1000	0.1%	0	Immediately	Basic setting	—
Pn473 (2473h)	Viscous friction compensation torque	0 ~ 3000	0.1%	0	Immediately	Basic setting	—
Pn474 (2474h)	Internal set speed hysteresis	0 ~ 100	0.1rpm	0	Immediately	Basic setting	—
Pn476 (2476h)	Gravity compensation	-1000 ~ 1000	0.1%	0	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn477 (2477h)	Friction recognition selection	0000H - 1121H	—	0000H	Immediately	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

Automatic friction force identification function selection		Reference
0	Disable	—
1	Enable	

Bit 1:

Friction recognition mode selection		Reference
0	Forward and backward Coulomb friction identification	—
1	Quadrant compensation automatic identification 1	
2	Quadrant compensation automatic identification 2	

Bit 2:

Friction identification tunning selection		Reference
0	Auto-tuning according to the identified quantity	—
1	Set value according to Pn47B/Pn47C	

Bit 3:

Torque selection for friction force identification		Reference
0	Moment selection mode 1 (optimum value)	—
1	Moment selection mode 2 (maximum value)	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn478 (2478h)	Forward Coulomb friction compensation filter time constant	0 ~ 12800	0.01ms	0	Immediately	Basic setting	—
Pn479 (2479h)	Inverse Coulomb friction compensation filter time constant	0 ~ 12800	0.01ms	0	Immediately	Basic setting	—
Pn47A (247Ah)	Detection velocity of friction force identification	10 ~ 100	rpm	40	Immediately	Basic setting	—
Pn47B (247Bh)	Auto-tuning of friction identification torque	1 ~ 50	0.1%	5	Immediately	Basic setting	—
Pn47C (247Ch)	Auto-tuning value of friction identification filtering time	10~300	1%	100	Immediately	Basic setting	—
Pn481 (2481h)	Gain of magnetic pole detection speed loop	10-20000	0.1Hz	40	Immediately	Tuning	—
Pn482 (2482h)	Integral time of magnetic pole detection velocity loop	15-51200	0.01ms	30000	Immediately	Tuning	—
Pn486 (2486h)	Pole detection command acceleration/deceleration time	0-100	ms	25	Immediately	Tuning	—
Pn487 (2487h)	Constant velocity time of magnetic pole detection command	0-300	ms	0	Immediately	Tuning	—
Pn488 (2488h)	Waiting time of magnetic pole detection command	50-500	ms	100	Immediately	Tuning	—
Pn490 (2490h)	Load value of magnetic pole detection	0-20000	%	0	Immediately	Tuning	—
Pn493 (2493h)	Pole detection command velocity	0-1000	rpm	50	Immediately	Tuning	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn494 (2494h)	Moving range of magnetic pole detection	1-65535	0.001rev	250	Immediately	Tuning	—
Pn495 (2495h)	Pole detection confirmation torque command	0-200	%	100	Immediately	Tuning	—
Pn498 (2498h)	Allowable range of magnetic pole detection error	0-30	deg	10	Immediately	Tuning	—
Pn4A0 (24A0h)	Pole detection mode selection	0-5	—	0	Immediately	Tuning	—

Pn4A0 (24A0h): n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Polarity detection mode selection	Reference
0	Standard mode	—
1	Jog mode	
2	Pre-location mode	

Bit 3, Bit 2, Bit 1: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn502 (2502h)	Rotational detected value	1 ~ 10000	rpm	20	Immediately	Basic setting	—
Pn503 (2503h)	Detection width of signal at the same velocity	0 ~ 100	rpm	10	Immediately	Basic setting	—
Pn506 (2506h)	Brake command - servo OFF delay time	0 ~ 100	10ms	20	Immediately	Basic setting	—
Pn507 (2507h)	Output velocity value of brake command	0 ~ 10000	rpm	100	Immediately	Basic setting	—
Pn508 (2508h)	Servo OFF - Brake command waiting time	1 ~ 100	10ms	50	Immediately	Basic setting	—
Pn509 (2509h)	Instantaneous outage holding time	20 ~ 50000	1ms	20	Immediately	Basic setting	—
Pn51E (251Eh)	Position bias too large warning value	10 ~ 100	1%	100	Immediately	Basic setting	—
Pn520 (2520h)	Position bias too large alarm value	1 ~ 1073741823	1 Unit	52428800	Immediately	Basic setting	—
Pn522 (2522h)	Positioning finished width	0 ~ 1073741824	1 Unit	5872	Immediately	Basic setting	—
Pn524 (2524h)	NEAR signal range	1 ~ 1073741824	1 Unit	1073741824	Immediately	Basic setting	—
Pn526 (2526h)	Position bias too large alarm value when servo ON	1 ~ 1073741823	1 Unit	524288000	Immediately	Basic setting	—
Pn528 (2528h)	Excessive position bias warning value when servo is ON	10 ~ 100	1%	100	Immediately	Basic setting	—
Pn529 (2529h)	Velocity limit when servo ON	0 ~ 10000	rpm	10000	Immediately	Basic setting	—
Pn52B (252Bh)	Overload warning value	1 ~ 100	1%	20	Immediately	Basic setting	—
Pn52C (252Ch)	Motor overload detection base current reduced rated value	10 ~ 100	1%	100	After restart	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn52D (252Dh)	Default power of single-phase power supply	10 ~ 100	1%	100	After restart	Basic setting	—
Pn52F (252Fh)	Monitoring display when power is on	0000H - 0FFFH	—	0FFFH	After restart	Basic setting	—
Pn530 (2530h)	Program JOG operation type selection	0000H - 0005H	-	0000H	Immediately	Basic setting	—

n. □□□□ (Bit 3, Bit 2, Bit 1, Bit 0)

Bit 0:

	Program JOG operating mode selection	Reference
0	Waiting time Pn535 → forward movement Pn531) × number of movements Pn536.	—
1	Waiting time Pn535 → reverse movement Pn531) × number of movements Pn536.	
2	Waiting time Pn535 → forward movement Pn531) × number of movements Pn536.	
3	Waiting time Pn535 → reverse movement Pn531) × number of movements Pn536.	
4	Waiting time Pn535 → reverse movement Pn531) × number of movements Pn536.	
5	Waiting time Pn535 → forward movement Pn531) × number of movements Pn536.	

Bit 1: Reserved parameter (Do not change.)

Bit 2: Reserved parameter (Do not change.)

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn531 (2531h)	Program JOG Travel Distance	1 ~ 1073741824	1 Uint	32768	Immediately	Basic setting	—
Pn533 (2533h)	Program JOG Movement Velocity	1 ~ 10000	rpm	500	Immediately	Basic setting	—
Pn534 (2534h)	Program JOG acceleration and deceleration time	2 ~ 10000	1ms	100	Immediately	Basic setting	—
Pn535 (2535h)	Program JOG Wait Time	0 ~ 10000	1ms	100	Immediately	Basic setting	—
Pn536 (2536h)	Program JOG Movements Count	0 ~ 1000	1 time	1	Immediately	Basic setting	—
Pn560 (2560h)	Residual vibration detection amplitude	1 ~ 3000	0.1%	400	Immediately	Basic setting	—
Pn561 (2561h)	Overshoot detection value	0 ~ 100	1%	100	Immediately	Basic setting	—
Pn562 (2562h)	Viscous friction compensation	0 ~ 5000	0.1%/1000rpm	0	Immediately	Basic setting	—
Pn563 (2563h)	Percentage friction compensation	0 ~ 1000	0.1%	0	Immediately	Basic setting	—
Pn564 (2564h)	Friction compensation smoothing constant(deceleration)	0 ~ 1000	0.1rpm	0	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn565 (2565h)	Friction compensation smoothing constant (acceleration)	0 ~ 1000	0.1rpm	0	Immediately	Basic setting	—
Pn566 (2566h)	Friction compensation smoothing selection	0 ~ 100	-	0	Immediately	Basic setting	—
Pn590 (2590h)	DI1 input signal setting	0000H - 53FFH	—	1001H	After restart	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 1, Bit 0:

	Signal configuration	Reference
00	Undefined	—
01	Forward Override Switch (POT)	
02	Reverse over-travel switch (NOT)	
03	Home switch DEC (DEC)	
06	Emergency Shutdown (FSTP)	
07	Forward Torque Limit (P_CL)	
08	Reverse torque limit (N_CL)	
0F	Alarm reset signal (ALMCLR)	
11	User-defined signal 0 (USER0)	
12	User-defined signal 1 (USER1)	
13	User-defined signal 2 (USER2)	
14	User-defined Signal 3 (USER3)	
15	User-defined Signal 4 (USER4)	
16	User-defined signal 5 (USER5)	
17	User-defined signal 6 (USER6)	

Bit 2:

	Polarity control	Reference
0	Open	—
1	Close	
2	Forced invalid	
3	Forced valid	

Bit 3:

	Axes selection	Reference
0	Not used	—
1	Axis A	
5	All Axes	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn591 (2592h)	DI2 input signal setting	0000H - 53FFH	—	1002H	After restart	Basic setting	—
	Same as PN590 DI1 input signal setting signal allocation						

K • Parameter List

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn592 (2592h)	DI3 input signal setting	0000H~53FFH	—	1004H	After restart	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 1, Bit 0 →

Signal configuration		Reference
00	Undefined	—
01	Forward Override Switch (POT)	
02	Reverse over-travel switch (NOT)	
03	Home switch DEC (DEC)	
04	Probe 0 (LATCH_0)	
05	Probe 1 (LATCH_1)	
06	Emergency Shutdown (FSTP)	
07	Forward torque limit (P_CL)	
08	Reverse torque limit (N_CL)	
0F	Alarm reset signal (ALMCLR)	
11	User-defined signal 0 (USER0)	
12	User-defined signal 1 (USER1)	
13	User-defined signal 2 (USER2)	
14	User-defined Signal 3 (USER3)	
15	User-defined Signal 4 (USER4)	
16	User-defined signal 5 (USER5)	
17	User-defined signal 6 (USER6)	

Bit 2 →

Polarity control		Reference
0	Open	—
1	Close	
2	Forced invalid	
3	Forced valid	

Bit 3 →

Axes selection		Reference
0	Not used	—
1	Axis A	
5	All Axes	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn593 (2593h)	DI4 input signal setting	0000H~53FFH	—	1005H	After restart	Basic setting	—
	Same as PN592 DI3 input signal setting signal allocation						
Pn594 (2594h)	DI5 input signal setting	0000H~53FFH	—	1003H	After restart	Basic setting	—
	Same as PN590 DI1 input signal setting signal allocation						
Pn595 (2595h)	DI6 input signal setting	0000H - 53FFH	—	2001H	After restart	Basic setting	—
	Same as PN590 DI1 input signal setting signal allocation						
Pn596 (2596h)	DI7 input signal setting	0000H - 53FFH	—	2002H	After restart	Basic setting	—
	Same as PN590 DI1 input signal setting signal allocation						
Pn597 (2597h)	DI8 input signal setting	0000H~53FFH	—	2004H	After restart	Basic setting	—
	Same as PN592 DI3 input signal setting signal allocation						
Pn598 (2598h)	DI9 input signal setting	0000H~53FFH	—	2005H	After restart	Basic setting	—
	Same as PN592 DI3 input signal setting signal allocation						
Pn599 (2599h)	DI10 input signal setting	0000H - 53FFH	—	2003H	After restart	Basic setting	—
	Same as PN590 DI1 input signal setting signal allocation						

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn59A	DI11 input signal setting	0000H - 53FFH	—	0000H	After restart	Basic setting	—
(259Ah)	Same as PN590 DI1 input signal setting signal allocation						
Pn59B	DI12 input signal setting	0000H - 53FFH	—	0000H	After restart	Basic setting	—
(259Bh)	Same as PN590 DI1 input signal setting signal allocation						
Pn59C	DI13 input signal setting	0000H~53FFH	—	0000H	After restart	Basic setting	—
(259Ch)	Same as PN592 DI3 input signal setting signal allocation						
Pn59D	DI14 input signal setting	0000H~53FFH	—	0000H	After restart	Basic setting	—
(259Dh)	Same as PN592 DI3 input signal setting signal allocation						
Pn59E	DI15 input signal setting	0000H - 53FFH	—	0000H	After restart	Basic setting	—
(259Eh)	Same as PN590 DI1 input signal setting signal allocation						
Pn59F	DI16 input signal setting	0000H - 53FFH	—	0000H	After restart	Basic setting	—
(259Fh)	Same as PN590 DI1 input signal setting signal allocation						
Pn5A0	DI17 input signal setting	0000H - 53FFH	—	0000H	After restart	Basic setting	—
(25A0h)	Same as PN590 DI1 input signal setting signal allocation						
Pn5A1	DI18 input signal setting	0000H~53FFH	—	0000H	After restart	Basic setting	—
(25A1h)	Same as PN592 DI3 input signal setting signal allocation						
Pn5A2	DI19 input signal setting	0000H~53FFH	—	0000H	After restart	Basic setting	—
(25A2h)	Same as PN592 DI3 input signal setting signal allocation						
Pn5A3	DI20 input signal setting	0000H - 53FFH	—	0000H	After restart	Basic setting	—
(25A3h)	Same as PN590 DI1 input signal setting signal allocation						
Pn5A4	DI21 input signal setting	0000H - 53FFH	—	5006H	After restart	Basic setting	—
(25A4h)	Same as PN590 DI1 input signal setting signal allocation						

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn5B0 (25AFh)	DO1 output signal setting	0000H - 53FFH	—	1004H	After restart	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 1, Bit 0:

	Signal configuration	Reference
00	Undefined	—
01	Forward Override Switch (POT)	
02	Reverse over-travel switch (NOT)	
03	Origin switch DEC (DEC)	
04	Probe 1 (LATCH_1)	
05	Probe 2 (LATCH_1)	
06	Emergency Shutdown (FSTP)	
07	Forward Torque Limit (P_CL)	
08	Reverse torque limit (N_CL)	
0F	Alarm reset signal (ALMCLR)	
11	User-defined signal 0 (USER0)	
12	User-defined signal 1 (USER1)	
13	User-defined signal 2 (USER2)	
14	User-defined Signal 3 (USER3)	
15	User-defined Signal 4 (USER4)	
16	User-defined signal 5 (USER5)	
17	User-defined signal 6 (USER6)	

Bit 2:

	Polarity Selection	Reference
0	Open	—
1	Close	
2	Forced invalid	
3	Forced valid	

Bit 3:

	Axis selection	Reference
0	Not used	—
1	Axis A	
5	All Axes	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn5B1 (25B1h)	DO2 output signal setting	0000H - 53FFH	—	1014H	After restart	Basic setting	—
	Same as PN5B0 DO1 input signal setting signal allocation						
Pn5B2 (25B2h)	DO3 output signal setting	0000H - 53FFH	—	2004H	After restart	Basic setting	—
	Same as PN5B0 DO1 input signal setting signal allocation						
Pn5B3 (25B3h)	DO4 output signal setting	0000H - 53FFH	—	2014H	After restart	Basic setting	—
	Same as PN5B0 DO1 input signal setting signal allocation						
Pn5B4 (25B4h)	DO5 output signal setting	0000H - 53FFH	—	3004H	After restart	Basic setting	—
	Same as PN5B0 DO1 input signal setting signal allocation						
Pn5B5 (25B5h)	DO6 output signal setting	0000H - 53FFH	—	3014H	After restart	Basic setting	—
	Same as PN5B0 DO1 input signal setting signal allocation						
Pn5B6 (25B6h)	DO7 output signal setting	0000H - 53FFH	—	4004H	After restart	Basic setting	—
	Same as PN5B0 DO1 input signal setting signal allocation						
Pn5B7 (25B7h)	DO8 output signal setting	0000H - 53FFH	—	4014H	After restart	Basic setting	—
	Same as PN5B0 DO1 input signal setting signal allocation						

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn5C0 (25C0h)	Total DI filter parameter (used when common IO filter time is 0)	0-5000	0.1ms	10	Immediately	Basic setting	—
Pn5C1 (25C1h)	DI1 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5C2 (25C2h)	DI2 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5C3 (25C3h)	DI3 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0, Bit 1:

	Probe filter time (probe function only, common IO manual input)	Reference
0	0ns	—
1	25ns	
2	50ns	
3	100ns	
4	150ns	
5	200ns	
6	300ns	
7	400ns	
8	600ns	
9	800ns	
A	1.0us	
B	1.2us	
C	1.6us	
D	2.0us	
E	2.4us	
F	3.2us	

Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn5C4 (25C4h)	DI4 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
	Same as Pn5C3 DI3 filter parameter						
Pn5C5 (25C5h)	DI5 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5C6 (25C6h)	DI6 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5C7 (25C7h)	DI7 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5C8 (25C8h)	DI8 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
	Same as Pn5C3 DI3 filter parameter						
Pn5C9 (25C9h)	DI9 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
	Same as Pn5C3 DI3 filter parameter						
Pn5CA (25CAh)	DI10 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5CB (25CBh)	DI11 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5CC (25CCh)	DI12 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn5CD (25CDh)	DI13 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
	Same as Pn5C3 DI3 filter parameter						
Pn5CE (25CEh)	DI14 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
	Same as Pn5C3 DI3 filter parameter						
Pn5CF (25CFh)	DI15 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5D0 (25CD0)	DI16 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5D1 (25CD1)	DI17 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5D2 (25CD2)	DI18 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
	Same as Pn5C3 DI3 filter parameter						
Pn5D3 (25CD3)	DI19 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
	Same as Pn5C3 DI3 filter parameter						
Pn5D4 (25CD4)	DI20 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5D5 (25CD5)	DI21 filter parameter	0-5000	0.1ms	0	Immediately	Basic setting	—
Pn5F6 (25CF6)	Lifting value at BK	-25000-25000	0.0001rev /0.01mm	0	Immediately	Basic setting	—
Pn5F7 (25CF7)	Maximum lifting velocity at BK	0-65535	1rpm	0	Immediately	Basic setting	—
Pn5F8 (25CF8)	Lifting acceleration and deceleration time at BK	0-65535	1ms	0	Immediately	Basic setting	—
Pn600 (2600h)	Brake resistance capacity *1	Based on model 0-65536*2	10W	0	Immediately	Basic setting	—

Note: * 1 Generally set to "0". When the external brake resistor is used, set the capacity value (W) of the resistor.

2. The upper limit is the maximum output capacity (W) of the applicable servo unit.

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn602 (2602h)	Motor type selection	0000H~0100H	—	0000H	After restart	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 1, Bit 0: Reserved parameter (Do not change.)

Bit 2:

Motor type（Source of motor parameters）		Reference
0	HCFA Motor (Electronic Tag)	—
1	Third party Motor	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn603 (2603h)	Natural frequency of motor selection	0000H - FFFFH	—	0001H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

Natural frequency of motor selection		Reference
0	Use frequency in PnE29	—
1	Use frequency in motor parameters	

Bit 1: Reserved parameter (Do not change.)

Bit 2: Reserved parameter (Do not change.)

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn605 (2605h)	First Encoder Configuration	0000H - FFFFH	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

The first encoder type selection		Reference
0	HCFA encoder	—
1	BISS encoder	
6	INV encoder	

Bit 1:

First encoder communication frequency selection		Reference
0	2.5M	—
1	1M	
2	2M	
3	3M	
4	4M	
5	5M	
6	8M	

Bit 2, Bit 3:

The first encoder shift selection	Reference
Represented by 2^n, such as 23bit, directly write 17H	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn609 (2609h)	Application function selection	0000H - FFFFH	—	0000H	After restart	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0: Bit0: Ground overcurrent (A.102) detection switch (0: open, 1: close)

Bit 1:
Bit4: Phase loss detection switch (0: off, 1: on)
Bit5: gravity compensation switch (0: off, 1: on)
Bit7: delay off enable switch (0: off, 1: on)

Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn60D (260Dh)	Alarm delay disable time	0~500	ms	0	After restart	—	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn60E (260Eh)	User torque overload threshold	0-65535	%	0	After restart	—	—
Pn60F (260Fh)	User torque overload time	0-1000	10ms	0	After restart	—	—
Pn610 (2610h)	Position comparison output function	0-3	—	0	After restart	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Position comparison output function	Reference
0	Close	—
1	Forward comparison	
2	Reverse comparison	
3	Two-way comparison	

Bit 1–Bit 3: Reserved parameter (Do not change.)

Pn611 (2611h)	First set position	-1073741824 ~ 1073741823	Unit	0	Immediately	—	—
Pn613 (2613h)	Second set position	-1073741824 ~ 1073741823	Unit	0	Immediately	—	—
Pn615 (2615h)	Third set position	-1073741824 ~ 1073741823	Unit	0	Immediately	—	—
Pn617 (2617h)	Fourth set position	-1073741824 ~ 1073741823	Unit	0	Immediately	—	—
Pn619 (2619h)	Effective time of the first set position output signal	0-65535	ms	0	Immediately	—	—
Pn61A (261Ah)	Effective time of second set position output signal	0-65535	ms	0	Immediately	—	—
Pn61B (261Bh)	Effective time of the third set position output signal	0-65535	ms	0	Immediately	—	—
Pn61C (261Ch)	Effective time of the fourth set position output signal	0-65535	ms	0	Immediately	—	—
Pn61D (261Dh)	Position comparison delay compensation	0-625	0.1us	0	Immediately	—	—
Pn61F (261Fh)	Application function selection 61F	0000H~FFFFH	—	0000H	After restart	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Torque overload function switch	Reference
0	close	—
1	open	

Bit 1–Bit 3: Reserved parameter (Do not change.)

Pn630 (2630h)	Resistance of external brake resistor	0~65535	10mΩ	0	After restart	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn631 (2631h)	Gravity compensation function switch	0000H - 0002H	-	0000H	Immediately	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

	Automatic update of gravity compensation value selection	Reference
0	Auto Update Off	—
1	value not persistent	
2	Persistent value	

Bit 1, Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn640 (2640h)	Black box function configuration	0000H - FFFFH	-	0011H	After restart	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

Bit0 black box switch
0 :OFF, 1 :ON
Bit1 Trigger mode
0 : Triggered by any alarm
1 : Triggered by specific alarm

Bit 1:

	Black box latch alarm code setting	Reference
0	Latch the data of the first ten alarms	—
1	Data of five times before and after latch alarm	
2	Latch data ten times after alarm	

Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn641 (2641h)	Black box latch alarm code setting	0000H - FFFFH	—	0000H	After restart	—	—
Pn645 (2645h)	The variable trace function tracks the 16-bit variable actual address assignment	00000000-FFFFFFFF	—	00000000	Immediately	Basic setting	—
Pn646 (2646h)	The variable trace function tracks the 32-bit variable actual address assignment	00000000-FFFFFFFF	—	00000000	Immediately	Basic setting	—
Pn660 (2660h)	Current command setting	0-10000	-	0	After restart	Basic setting	—
Pn661 (2661h)	Phase angle setting	0-500	-	0	After restart	Basic setting	—
Pn66F (266Fh)	Online inertia update time	0-65535	min	0	Immediately	Basic setting	—
Pn670 (2670h)	Online inertia identification setting	0-3	-	0	Immediately	Basic setting	—
Pn676 (2676h)	Internal brake configuration	0~8203	-	0	After restart	Basic setting	—
Pn678 (2678h)	Auto-tuning rigid setting	0-41	—	4	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn679 (2679h)	Auto-tuning mode	0000-0006H	—	0000H	Immediately	Basic setting	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 1, Bit 0:

	Auto-tuning mode	Reference
0	The parameter auto-tuning is invalid, and the gain parameter is manually tuning	—
1	Parameter auto-tuning mode, auto-tuning gain parameters with rigid meter	
2	Position mode, auto-tuning gain parameters with rigid meter	
3	Interpolation mode, automatic inertia identification	
4	Ordinary mode, automatic inertia identification	
5	Stune Mode 5	
6	Quick positioning mode, automatic inertia identification	

Bit 3, Bit 2: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn67A (267Ah)	Auto-tuning vibration treatment time	0-65535	s	300	Immediately	Basic setting	—
Pn67F (267Fh)	Probe delay compensation	-32768~32767	0.1us	0	Immediately	Basic setting	
Pn6A8 (26A8h)	Manual BK control	0~1	-	0	Immediately	Basic setting	—
Pn6A9 (26A9h)	Collision detection torque	0-300	1%	0	After restart	Basic setting	—
Pn6AA (26AAh)	Collision detection time	0-5000	ms	1	After restart	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6B0 (26B0h)	Advanced auto-tuning one-touch control (Fn202)	0~20	-	0	Immediately	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n.□□□□

	Advanced auto-tune one-touch control (Fn2 02)	Reference
00	Invalid tuning	—
01	Inertia Self-Indicated, Medium Rigid Structural Interpolation Mode	
02	Inertia Self-Indicated, Medium Rigid Structural fast positioning Mode	
03	Inertia Self-Indicated, Medium Rigid Structural Standard Mode	
04	Inertia Self-Indicated, Low Rigid Structural Interpolation Mode	
05	Inertia Self-Indicated, Low Rigid Structural fast positioning Mode	
06	Inertia Self-Indicated, Low Rigid Structural Standard Mode	
07	Inertia Self-Indicated, High Rigid Structural Interpolation Mode	
08	Inertia Self-Indicated, High Rigid Structural fast positioning Mode	
09	Inertia Self-Indicated, High Rigid Structural Standard Mode	
0B	Medium Rigid Structural Interpolation Mode	
0C	Medium Rigid Structural fast positioning Mode	
0D	Medium Rigid Structural Standard Mode	
0E	Low Rigid Structural Interpolation Mode	
0F	Low Rigid Structural fast positioning Mode	
10	Low Rigid Structural Standard Mode	
11	High Rigid Structural Interpolation Mode	
12	High Rigid Structural fast positioning Mode	
13	High Rigid Structural Standard Mode	

Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6B1 (26B1h)	Advanced auto-tuning one-touch control (Fn201)	0~20	-	0	Immediately	Basic setting	—
	Same as PN6B0 Advanced auto-tuning one-touch control (Fn202)						
Pn6B2 (26B2h)	Travel distance of advanced automatic tuning	-32767-32767	—	0	Immediately	Basic setting	—
Pn6B3 (26B3h)	Advanced auto-tuning initial gain level	0~5	—	2	Immediately	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n.□□□□

	Advanced auto-tuning initial gain level	Reference
0	No setting, refer to Pn100	—
1	Level 1	
2	Level 2 (default recommendation)	
3	Level 3	
4	Level 4	
5	Level 5	

Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6B4 (26B4h)	Advanced auto-tuning initial inertia level	0~3	—	2	Immediately	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 0, Bit 1:

Advanced auto-tuning initial inertia level		Reference
0	No setting, refer to Pn324	—
1	Low moment of inertia	
2	Medium moment of inertia (default recommendation)	
3	High moment of inertia	

Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6B5 (26B5h)	Advanced auto-tuning initial positioning accuracy	0~9	—	4	Immediately	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 0, Bit 1:

Advanced auto-tuning initial positioning accuracy		Reference
0	No setting, refer to Pn522	—
1	Level 1	
2	Level 2	
3	Level 3	
4	Level 4 (default recommendation)	
5	Level 5	
6	Level 6	
7	Level 7	
8	Level 8	
9	Level 9	

Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6B6 (26B6h)	Advanced Auto-tuning Gain Results Saved Percent	1-100	1%	70	Immediately	Basic setting	—
Pn6B7 (26B7h)	Advanced auto-tuning configuration function	0000H-1111H	—	0001H	Immediately	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 0:

Initial selection of "Auto-tuning related functions" when tuning is started		Reference
0	No initialization	—
1	Forced initialization	

Bit 1: Reserved parameter (Do not change.)

Bit 2:

Fn201 Motion distance source selection		Reference
0	Pn6B2 is taken as increment distance in the movement of Pn201	—
1	Pn6B8 and Pn6BA are taken as the maximum distance in the movement range of Pn201	

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6B8	Advanced auto-tuning _ start of motion interval (Negative limit)	-2147483648~ 2147483647	Unit	0	Immediately	Basic setting	—
Pn6BA	Advanced auto-tuning _ end of motion interval (Positive limit)	-2147483648~ 2147483647	Unit	0	Immediately	Basic setting	—
Pn6C0 (26C0h)	Main switch of gantry function	0000H-0011H	—	0010H	After restart	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 0:

Main switch of gantry function		Reference
0	Disable	—
1	Enable	

Bit 1:

Gantry homing mode		Reference
0	Master-slave independent homing	—
1	Slave axis follow master axis homing	

Bit 2: Bit8: Test

Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6C1 (26C1h)	Gantry slave axis function switch	0000H-0011H	—	0000H	Immediately	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 0:

Position compensation meter function		Reference
0	Disable	—
1	Enable	

Bit 1:

Synchronous compensation function		Reference
0	Disable	—
1	Enable	

Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6C2 (26C2h)	Gantry coordinated stop mode	0000H-0002H	—	0000H	Immediately	Basic setting	—

Bit 3 Bit 2 Bit 1 Bit 0

n. □ □ □ □

Bit 0:

Coordination stop function selection		Reference
0	Coordinated Stop Function Mode 1	—
1	Coordinated Stop Function Mode 2	

Bit 1, Bit 2, Bit 3: Reserved parameter (Do not change.)

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6C3 (26C3h)	Warning value of excessive position bias between gantry shafts	10-100	%	100	Immediately	Basic setting	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn6C4 (26C4h)	Alarm value for excessive position bias between gantry shafts	0-1073741823	Uint	1048576	Immediately	Basic setting	—
Pn6C5 (26C5h)	Alarm value for excessive differential torque between gantry shafts	0-6000	%	1000	Immediately	Basic setting	—
Pn6C6 (26C6h)	Gantry coordinated stop speed FF feedforward	0-100	%	0	Immediately	Basic setting	—
Pn6C7 (26C7h)	Proportional gain of gantry synchronous position loop	10-20000	0.1/s	400	Immediately	Basic setting	—
Pn6C8 (26C8h)	Integral time of synchronous position loop of gantry	0-50000	0.1ms	2000	Immediately	Basic setting	—
Pn6C9 (26C9h)	Gantry synchronous velocity limiting	0-1000	0.1%	20	Immediately	Basic setting	—
Pn6CA (26CAh)	Differential velocity limit between gantry coordinated stop axes	0-3000	rpm	300	Immediately	Basic setting	—
Pn6CB (26CBh)	Gantry coordination stop completion velocity threshold	0-1000	rpm	15	Immediately	Basic setting	—
Pn700	603F-Error code	0000H-FFFFH	—	0000H	Immediately	—	—
Pn701	6040-Control word	0000H-FFFFH	—	0000H	Immediately	—	—
Pn702	6041-Status word	0000H-FFFFH	—	0000H	Immediately	—	—
Pn703	605A-Quick shutdown mode selection	0-7	—	2	Immediately	—	—
Pn706	605D- Pause mode selection	0-4	—	1	Immediately	—	—
Pn707	605E- Fault Reaction Option Code	0-0	—	0	Immediately	—	—
Pn708	6060-Control mode	0-10	—	0	Immediately	—	—
Pn709	6061- Control mode display	0-10	—	0	—	—	—
Pn70A	6062-User position command	-2147483648-2147483647	cnt	0	Immediately	—	—
Pn70C	6063-Motor position feedback	-2147483648-2147483647	cnt	0	Immediately	—	—
Pn70E	6064- User position feedback	-2147483648-2147483647	cnt	0	Immediately	—	—
Pn710	6065- User position bias exceeded threshold	0-4294967295	cnt	0	Immediately	—	—
Pn712	6066- Position bias time window	0-65535	ms	0	Immediately	—	—
Pn713	6067- Position reached threshold	0-4294967295	cnt	50	Immediately	—	—
Pn715	6068- Position reached time	0-65535	ms	0	Immediately	—	—
Pn716	606B- User Velocity Command Value	-2147483648-2147483647	cnt/s	0	Immediately	—	—
Pn718	606C-User actual velocity feedback	-2147483648-2147483647	cnt/s	0	Immediately	—	—
Pn71A	606D- Velocity reached threshold	0-65535	rpm	10	Immediately	—	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn71B	606E- Velocity reached time	0-65535	ms	0	Immediately	—	—
Pn71C	6071- Torque target value	-32768-32767	0.1%	0	Immediately	—	—
Pn71D	6072-Maximum torque	0-65535	0.1%	8000	Immediately	—	—
Pn71E	6074- User defined torque value	-32768-32767	0.1%	0	Immediately	—	—
Pn71F	6076-Motor RPM Torque	0-4294967295	mN	0	Immediately	—	—
Pn721	6077-Actual torque feedback	-32768-32767	0.1%	0	Immediately	—	—
Pn722	607A- Target Position Value	-2147483648-2147483647	cnt	0	Immediately	—	—
Pn724	607C-Origin offset	-2147483648-2147483647	cnt	0	Immediately	—	—
Pn726	607D-Software Limit: Minimum Position Limit	-2147483648-2147483647	cnt	-2147483648	Immediately	—	—
Pn728	607D-Software Limit: Maximum Position Limit	-2147483648-2147483647	cnt	2147483647	Immediately	—	—
Pn72A	607E-Command polarity	0-255	-	0	Immediately	—	—
Pn72B	607F-Maximum profile velocity	0-4294967295	cnt/s	2147483647	Immediately	—	—
Pn72D	6080-Maximum Motor velocity	0-4294967295	cnt/s	10000	Immediately	—	—
Pn72F	6081- Profile Velocity	0-4294967295	cnt/s	0	Immediately	—	—
Pn731	6083- Profile acceleration velocity	0-4294967295	cnt/s^2	10485760	Immediately	—	—
Pn733	6084- Profile deceleration velocity	0-4294967295	cnt/s^2	10485760	Immediately	—	—
Pn735	6085-Quick stop deceleration	0-4294967295	cnt/s^2	10485760	Immediately	—	—
Pn738	6087-Torque ramp	0-4294967295	-	1000	Immediately	—	—
Pn73A	6098-Homing mode	0-35	-	0	Immediately	—	—
Pn73B	6099- Velocity of search deceleration signal in homing mode	0-4294967295	-	10485760	Immediately	—	—
Pn73D	6099- Velocity of search original signal in homing mode	0-4294967295	-	524288	Immediately	—	—
Pn73F	609A- Homing acceleration	0-4294967295	cnt/s^2	10485760	Immediately	—	—
Pn741	60B0- Position offset	-2147483648-2147483647	cnt	0	Immediately	—	—
Pn743	60B1- Velocity offset	-2147483648-2147483647	cnt/s	0	Immediately	—	—
Pn745	60B2- Torque offset	-32768~32767	0.1%	0	Immediately	—	—
Pn747	60B8- Probe Function	0000H-FFFFH	-	0000H	Immediately	—	—
Pn748	60B9- Probe status word	0000H-FFFFH	-	0000H	Immediately	—	—
Pn749	60BA- Probe 1 Rising Edge Position Feedback	-2147483648-2147483647	-	0	Immediately	—	—
Pn74A	60BB- Probe 1 falling edge position feedback	-2147483648-2147483647	-	0	Immediately	—	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn74B	60BC- probe 2 rising edge position feedback	-2147483648-2147483647	-	0	Immediately	—	—
Pn74C	60BD- Probe 2 falling edge position feedback	-2147483648-2147483647	-	0	Immediately	—	—
Pn74D	60C0- Interpolated sub-mode selection	-3-0	-	0	Immediately	—	—
Pn74E	60C1- Interpolated data record	0-4294967295	-	0	Immediately	—	—
Pn750	60C2- Interpolation time period	-6- -3	-	0	Immediately	—	—
Pn751	60C2- Interpolation time point	1-250	-	0	Immediately	—	—
Pn752	60E0- Forward Maximum Torque Limit	0-65535	-	8000	Immediately	—	—
Pn753	60E1- Reverse Maximum Torque Limit limit	0-65535	-	8000	Immediately	—	—
Pn754	60F4-User position bias	-2147483648-2147483647	-	0	Immediately	—	—
Pn756	60FC-Motor position command feedback	-2147483648-2147483647	-	0	Immediately	—	—
Pn758	60FD-DI input status	00000000H-FFFFFFFFH	-	00000000H	Immediately	—	—
Pn75A	60FE-DO Output Status	00000000H-FFFFFFFFH	-	00000000H	Immediately	—	—
Pn75C	60FE-Bit mask	00000000H-FFFFFFFFH	-	00000000H	Immediately	—	—
Pn75E	60FF-Target velocity	-2147483648-2147483647	cnt/s	0	Immediately	—	—
Pn760	6502-Servo operation mode supported	00000000H-FFFFFFFFH	-	000003ADH	Immediately	—	—
Pn761	60D5-Probe 1 Rising edge Count	0-65535	-	0	Immediately	—	—
Pn762	60D6-Probe 1 falling edge count	0-65535	-	0	Immediately	—	—
Pn763	60D7- Probe 2 Rising edge Count	0-65535	-	0	Immediately	—	—
Pn764	60D8- Probe 2 falling edge count	0-65535	-	0	Immediately	—	—
Pn776	System position 31:00 upper limit L	0-4294967295	-	0	Immediately	—	—
Pn778	System position 63:32 upper limit H	0-4294967295	-	0	Immediately	—	—
Pn77F	Homing timeout time	0-4294967295	100ms	10000	Immediately	—	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn781	Function conversion selection 0	0000H~1111H	—	0000H	Immediately	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Software limit switch		Reference
0	No software limit is used	6.5
1	Use software limit	

Unit transfer switch		Reference
0	No analog-digital function used	6.6
1	Use analog-digital function	

Unit transfer switch		Reference
0	Unit/s	—
1	rpm	

Homing mark persistent switch		Reference
0	Homing mark not persistent	5.10.6
1	Homing mark persistent	

Pn785	Synchronization Error Count Limits	2-32767	-	9	Immediately	—	—
Pn786	Station address setting	0-65535	-	0	After restart	—	—
Pn787	Function conversion selection 1	0000H~0010H	-	0000H	After restart	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Master station type

Master station type		Reference
0	Codesys and other platforms	—
1	Omron platform	

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

Pn788	Low 32 bits of analog-digital homing offset position	0-4294967295	-	0	Immediately	—	—
Pn789	High 32 bits of analog-digital homing offset position	0-4294967295	-	0	Immediately	—	—
Pn78A	Setting of upper limit value of analog-digital function position	0-4294967296	-	0	After restart	—	—
Pn78C	6091-Electronic gear ratio numerator	1-4294967295	-	1	Immediately	—	—
Pn78E	6091-Electronic gear ratio denominator	1-4294967295	-	1	Immediately	—	—

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn790	EtherCAT function conversion Selection 0	0000H~2100H	—	0000H	Immediately	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 1, Bit 0: Reserved parameter (Do not change.)

Bit 2:

Node ID function selection		Reference
0	controller	—
1	Servo drive	

Bit 3:

Parameter writing to EEPROM Selection		Reference
0	Parameter writing to EEPROM (except group 60)	5.15
1	All parameters are not written into EEPROM	
2	All parameters writing into EEPROM	

Pn No.	Signal	Setting range	Unit	Default Value	When effective	Classification	Reference
Pn793	EtherCAT function conversion selection 3	0000H~0001H	—	0000H	After restart	—	—

n. Bit 3 Bit 2 Bit 1 Bit 0

Bit 0:

Manual homing		Reference
0	Homing state	—
1	Manual homing in current position	

Bit 3, Bit 2, Bit 1: Reserved parameter (Do not change.)

11.3 Parameter List for Object Dictionary 2000H

Index	Pn	Name	Unit	Data Type	Data range	Default value	When to set	When effective
2000h	Pn000	Basic Function Selection 0	—	UINT	0~1	0	Set at stop	After restart
2001h	Pn001	Application Function Selection 1	—	UINT	0~358	54	Set at stop	After restart
2002h	Pn002	Application Function Selection 2	—	UINT	0~529	273	Set at stop	After restart
2008h	Pn008	Application Function Selection 8	—	UINT	0~16673	0	Set at stop	After restart
2009h	Pn009	Application Function Selection 9	—	UINT	0~304	16	Set at stop	After restart
200Ah	Pn00A	Application Function Selection A	—	UINT	0~98	0	Set at stop	After restart
200Bh	Pn00B	Application Function Selection B	—	UINT	0~353	49	Set at stop	After restart
200Ch	Pn00C	Application Function Selection C	—	UINT	0~305	0	Set at stop	After restart
200Dh	Pn00D	Application Function Selection D	—	UINT	0~4352	0	Set at stop	After restart
2080h	Pn080	Application Function Selection 80	—	UINT	0~257	0	Set at stop	After restart

2100h	Pn100	Velocity Loop Gain	0.1Hz	UINT	10-20000	400	Set at operation	Immediately
2101h	Pn101	Velocity Loop Integral Time Constant	0.01ms	UINT	15-51200	2000	Set at operation	Immediately
2102h	Pn102	Position Loop Gain	0.1/s	UINT	10-20000	400	Set at operation	Immediately
2103h	Pn103	Moment of Inertia Ratio	%	UINT	0-20000	100	Set at operation	Immediately
2104h	Pn104	Second Velocity Loop Gain	0.1hz	UINT	10-20000	400	Set at operation	Immediately
2105h	Pn105	Second Velocity Loop Integral Time Constant	0.01ms	UINT	15-51200	2000	Set at operation	Immediately
2106h	Pn106	Second Position Loop Gain	0.1/s	UINT	10-20000	400	Set at operation	Immediately
2107h	Pn107	Pseudo-differential feedforward control coefficient	0.1%	UINT	0~2000	0	Set at operation	Immediately
2109h	Pn109	Speed feedforward	%	UINT	0-100	0	Set at operation	Immediately
210Ah	Pn10A	Feedforward filter time constant	0.01ms	UINT	0-6400	0	Set at operation	Immediately
210Bh	Pn10B	Gain type application switch	—	UINT	0-21300	0	Set at stop	After restart
210Ch	Pn10C	Mode switch (torque command)	%	UINT	0-800	200	Set at operation	Immediately
210Dh	Pn10D	Mode switch (velocity command)	rpm	UINT	0-10000	0	Set at operation	Immediately
210Eh	Pn10E	Mode switch (acceleration)	rpm/s	UINT	0-30000	0	Set at operation	Immediately
210Fh	Pn10F	Mode switch (position bias)	Unit	UINT	0-10000	0	Set at operation	Immediately
2119h	Pn119	Torque feedforward	%	UINT	0~1000	0	Set at operation	Immediately
211Ah	Pn11A	Feedforward filter time constant	0.01ms	UINT	0~6400	0	Set at operation	Immediately
211Fh	Pn11F	Position integral time constant	0.1ms	UINT	0-50000	0	Set at operation	Immediately
2121h	Pn121	Friction compensation gain	%	UINT	10-1000	100	Set at operation	Immediately
2122h	Pn122	Second friction compensation gain	%	UINT	10-1000	100	Set at operation	Immediately
2123h	Pn123	Friction compensation coefficient	%	UINT	0-100	0	Set at operation	Immediately
2124h	Pn124	Friction compensation frequency compensation	0.1Hz	INT	-10000-10000	0	Set at operation	Immediately
2125h	Pn125	Friction compensation gain compensation	%	UINT	1-1000	100	Set at operation	Immediately
2127h	Pn127	Velocity Observer Gain	Hz	UINT	1-500	40	Set at operation	Immediately

2128h	Pn128	Velocity Observer Position Compensation Gain	%	UINT	1-1000	150	Set at operation	Immediately
2131h	Pn131	Gain switching time 1	ms	UINT	0-65535	0	Set at operation	Immediately
2132h	Pn132	Gain switching time 2	ms	UINT	0-65535	0	Set at operation	Immediately
2135h	Pn135	Gain switching waiting time 1	ms	UINT	0-65535	0	Set at operation	Immediately
2136h	Pn136	Gain switching waiting time 2	ms	UINT	0-65535	0	Set at operation	Immediately
2137h	Pn137	Gain switching level 1	—	UINT	0-20000	0	Set at operation	Immediately
2138h	Pn138	Gain switching level 2	—	UINT	0-20000	0	Set at operation	Immediately
2139h	Pn139	Automatic gain type change-over switch 1	—	UINT	0~162	0000H	Set at operation	Immediately
213Dh	Pn13D	Current gain value	%	UINT	100~2000	2000	Set at operation	Immediately
2140h	Pn140	Model tracking control switch	—	UINT	0~4385	0100H	Set at operation	Immediately
2141h	Pn141	Model Tracking Control Gain	0.1/s	UINT	10-20000	500	Set at operation	Immediately
2142h	Pn142	Model following control gain compensation	0.1%	UINT	500-2000	1000	Set at operation	Immediately
2143h	Pn143	Model Tracking Control Offset (Forward Direction)	0.1%	UINT	0-10000	1000	Set at operation	Immediately
2144h	Pn144	Model Tracking Control Offset (Reverse Direction)	0.1%	UINT	0-10000	1000	Set at operation	Immediately
2145h	Pn145	Vibration suppression 1 frequency A	0.1Hz	UINT	10-2500	500	Set at operation	Immediately
2146h	Pn146	Vibration suppression 1 frequency B	0.1Hz	UINT	10-2500	700	Set at operation	Immediately
2147h	Pn147	Model tracking control speed feedforward compensation	0.1%	UINT	0-10000	1000	Set at operation	Immediately
2148h	Pn148	Model 2 Tracking Control Gain	0.1/s	UINT	10-20000	500	Set at operation	Immediately
2149h	Pn149	Model 2 Tracking Control Gain Correction	0.1%	UINT	500-2000	1000	Set at operation	Immediately
214Ah	Pn14A	Vibration suppression 2 frequency	0.1Hz	UINT	10-2000	800	Set at operation	Immediately
214Bh	Pn14B	Vibration suppression 2 correction	%	UINT	10-1000	100	Set at operation	Immediately
214Fh	Pn14F	Control type selection	—	UINT	0-33	33	Set at stop	After restart
2160h	Pn160	Vibration suppression control switch	—	UINT	0-17	16	Set at operation	Immediately
2161h	Pn161	Type A vibration suppression frequency	0.1Hz	UINT	10-20000	1000	Set at operation	Immediately

2162h	Pn162	Type A vibration suppression gain correction	%	UINT	1-1000	100	Set at operation	Immediately
2163h	Pn163	Attenuation gain of type A vibration suppression	%	UINT	0-300	0	Set at operation	Immediately
2164h	Pn164	Type A vibration suppression filter time constant 1 correction	0.01ms	INT	-1000-1000	0	Set at operation	Immediately
2165h	Pn165	Type A vibration suppression filter time constant 2 correction	0.01ms	INT	-1000-1000	0	Set at operation	Immediately
2166h	Pn166	A-type vibration suppression attenuation gain 2	—	UINT	0-1000	0	Set at operation	Immediately
2167h	Pn167	Cut-off frequency of Type A damped high-pass filter	—	UINT	10-50000	20000	Set at operation	Immediately
2170h	Pn170	Non-tuning type switch	—	UINT	0-10001	5120	Set at stop	After restart
2207h	Pn207	Position control function switch	—	UINT	0~8192	0	Set at stop	After restart
2216h	Pn216	Position command acceleration/deceleration time parameter	0.1ms	UINT	0-65535	0	Set at operation	Immediately
2217h	Pn217	Average time of position command movement	0.1ms	UINT	0-10000	0	Set at operation	Immediately
2219h	Pn219	Position command 2nd-order low-pass filter cutoff frequency	0.1Hz	UINT	0~10000	0	Set at operation	Immediately
2230h	Pn230	Position control extended function switch	—	UINT	0-1	0	Set at stop	After restart
2231h	Pn231	Backlash compensation amount	0.1Unit	DINT	-500000-500000	0	Set at operation	Immediately
2233h	Pn233	Time parameter of backlash compensation	0.01ms	UINT	0-65535	0	Set at operation	Immediately
2260h	Pn260	Low-frequency vibration suppression mode selection	—	UINT	0-1	0	Set at operation	Immediately
2261h	Pn261	Low frequency resonance frequency A	0.1Hz	UINT	0-5000	0	Set at operation	Immediately
2262h	Pn262	Suppression width of low-frequency resonance frequency A	—	UINT	0-10	2	Set at operation	Immediately
2263h	Pn263	Suppression depth of low-frequency resonance frequency A	—	UINT	0-1000	5	Set at operation	Immediately
2290h	Pn290	Cutting vibration enable	—	UINT	0~1	0	Set at operation	Immediately
2291h	Pn291	Cutting vibration maximum limit	0.1%rev	UINT	0~300	100	Set at operation	Immediately
2292h	Pn292	Cutting vibration amplitude	Unit	UINT	0~32767	0	Set at operation	Immediately

2293h	Pn293	Cutting vibration frequency	0.1Hz	UINT	10~500	100	Set at operation	Immediately
2304h	Pn304	JOG Velocity	0.01rpm	UINT	0-1000000	50000	Set at operation	Immediately
2305h	Pn305	Soft start acceleration time	ms	UINT	0~65535	0	Set at operation	Immediately
2306h	Pn306	Soft start deceleration time	ms	UINT	0~65535	0	Set at operation	Immediately
2307h	Pn307	Velocity command filter time parameters	0.01ms	UINT	0~65535	0	Set at operation	Immediately
2308h	Pn308	Velocity Feedback Filter Time Parameters	0.01ms	UINT	0-65535	0	Set at operation	Immediately
230Ah	Pn30A	Stop deceleration time	ms	UINT	0~10000	100	Set at operation	Immediately
230Ch	Pn30C	Moving average time of velocity feedforward	0.1ms	UINT	0-5100	0	Set at operation	Immediately
2310h	Pn310	Vibration detection switch	—	UINT	0-2	0	Set at operation	Immediately
2311h	Pn311	Vibration detection sensitivity	%	UINT	50-500	100	Set at operation	Immediately
2312h	Pn312	Vibration detection value	rpm	UINT	0-5000	50	Set at operation	Immediately
2316h	Pn316	Maximum motor velocity	rpm	UINT	0-65535	10000	Set at stop	After restart
2324h	Pn324	Calculated initial value of moment of inertia	%	UINT	0-20000	300	Set at operation	Immediately
2325h	Pn325	Vibration Detection Level in Moment of Inertia Identification	rpm	UINT	0-5000	250	Set at operation	Immediately
2401h	Pn401	The first segment 1st torque command filter time constant	0.01ms	UINT	0-65535	100	Set at operation	Immediately
2402h	Pn402	Forward torque limit	%	UINT	0-800	800	Set at operation	Immediately
2403h	Pn403	Reverse torque limit	%	UINT	0-800	800	Set at operation	Immediately
2404h	Pn404	External torque limit of forward rotating side	%	UINT	0-800	100	Set at operation	Immediately
2405h	Pn405	External torque limit on reverse side	%	UINT	0-800	100	Set at operation	Immediately
2406h	Pn406	Emergency stop torque	%	UINT	0-800	800	Set at operation	Immediately
2407h	Pn407	Velocity limit at torque control	rpm	UINT	0-10000	10000	Set at operation	Immediately
2408h	Pn408	Torque type function switch	—	UINT	0-4369	0	Set at stop	After restart
2409h	Pn409	The first segment notch filter frequency	Hz	UINT	50-5000	5000	Set at operation	Immediately
240Ah	Pn40A	Q value of the first segment notch filter	0.01	UINT	50-1000	70	Set at operation	Immediately

240Bh	Pn40B	The first segment notch filter depth	0.001	UINT	0-1000	0	Set at operation	Immediately
240Ch	Pn40C	The second segment notch filter frequency	Hz	UINT	50-5000	5000	Set at operation	Immediately
240Dh	Pn40D	Q value of the second segment notch filter	0.01	UINT	50-1000	70	Set at operation	Immediately
240Eh	Pn40E	The second segment notch filter depth	0.001	UINT	0-1000	0	Set at operation	Immediately
240Fh	Pn40F	The second Segment 2nd torque command filter frequency	Hz	UINT	100-5000	5000	Set at operation	Immediately
2410h	Pn410	Q value of the second segment torque command filter	0.01	UINT	50-100	50	Set at operation	Immediately
2412h	Pn412	The first segment 2nd torque command filter time constant	0.01ms	UINT	0-65535	100	Set at operation	Immediately
2416h	Pn416	Torque type function switch 2	Hz	UINT	0~273	0	Set at operation	Immediately
2417h	Pn417	The third segment notch filter frequency	Hz	UINT	50~5000	5000	Set at operation	Immediately
2418h	Pn418	Q value of the third segment notch filter	0.01	UINT	50-1000	70	Set at operation	Immediately
2419h	Pn419	The third segment notch filter depth	0.001	UINT	0-1000	0	Set at operation	Immediately
241Ah	Pn41A	The fourth segment notch filter frequency	Hz	UINT	50-5000	5000	Set at operation	Immediately
241Bh	Pn41B	Q value of the fourth segment notch filter	0.01	UINT	50-1000	70	Set at operation	Immediately
241Ch	Pn41C	The fourth segment notch filter depth	0.001	UINT	0-1000	0	Set at operation	Immediately
241Dh	Pn41D	The fifth segment notch filter frequency	Hz	UINT	50-5000	5000	Set at operation	Immediately
241Eh	Pn41E	Q value of the fifth segment notch filter	0.01	UINT	50-1000	70	Set at operation	Immediately
241Fh	Pn41F	The fifth segment notch filter depth	0.001	UINT	0~1000	0	Set at operation	Immediately
2423h	Pn423	Velocity ripple compensation switch (rotary)	—	UINT	0-4369	0	Set at operation	Immediately
2424h	Pn424	Torque limit at main circuit voltage drop	%	UINT	0-100	50	Set at operation	Immediately
2425h	Pn425	Release time for torque limit at main circuit voltage drop	ms	UINT	0-1000	100	Set at operation	Immediately
2426h	Pn426	Torque feedforward moving average time	0.1ms	UINT	0-5100	0	Set at operation	Immediately
2427h	Pn427	Velocity ripple compensation effective velocity (rotary)	rpm	UINT	0-10000	0	Set at operation	Immediately

2453h	Pn453	Sweep start frequency	Hz	UINT	1-5000	400	Set at operation	Immediately
2454h	Pn454	Sweep end frequency	Hz	UINT	50-5000	4000	Set at operation	Immediately
2455h	Pn455	Detected resonance frequency lower limit	Hz	UINT	50-5000	500	Set at operation	Immediately
2456h	Pn456	Sweep torque command amplitude	%	UINT	1-800	15	Set at operation	Immediately
2457h	Pn457	FFT-related function switch	—	UINT	0-10050	528	Set at stop	After restart
2460h	Pn460	Notch filter adjustment switch	—	UINT	0-257	257	Set at operation	Immediately
2466h	Pn466	Adaptive notch filter mode selection	—	UINT	0-7	4	Set at operation	Immediately
2471h	Pn471	Forward coulomb friction compensation torque	0.1%	UINT	0-1000	0	Set at operation	Immediately
2472h	Pn472	Reverse coulomb friction compensation torque	0.1%	UINT	0-1000	0	Set at operation	Immediately
2473h	Pn473	Viscous friction compensation torque	0.1%	UINT	0-3000	0	Set at operation	Immediately
2474h	Pn474	Internally set speed hysteresis	0.1rpm	UINT	0-100	0	Set at operation	Immediately
2476h	Pn476	Gravity compensation torque	0.1%	INT	-1000~1000	0	Set at operation	Immediately
2477h	Pn477	Friction identification switch	—	UINT	0-4385	0	Set at operation	Immediately
2478h	Pn478	Filtering time for forward coulomb friction compensation	ms	UINT	0-12800	0	Set at operation	Immediately
2479h	Pn479	Filtering time for reverse coulomb friction compensation	ms	UINT	0-12800	0	Set at operation	Immediately
247Ah	Pn47A	Detection speed for friction identification	rpm	UINT	10-100	40	Set at operation	Immediately
247Bh	Pn47B	Self-adjustment quantity of torque for friction identification	0.1%	UINT	1-50	5	Set at operation	Immediately
247Ch	Pn47C	Self-adjustment quantity of filtering time for friction identification	0.1%	UINT	10-300	100	Set at operation	Immediately
2481h	Pn481	Polarity detection velocity loop gain	0.1HZ	UINT	10-20000	40	Set at operation	Immediately
2482h	Pn482	Polarity detection velocity loop integral time constant	0.01ms	UINT	15-51200	30000	Set at operation	Immediately
2486h	Pn486	Polarity detection command acceleration/ deceleration time	ms	UINT	0-100	25	Set at operation	Immediately
2487h	Pn487	Polarity detection constant velocity time	ms	UINT	0-300	0	Set at operation	Immediately

2488h	Pn488	Polarity detection command waiting time	ms	UINT	50-500	100	Set at operation	Immediately
2490h	Pn490	Polarity detection load value	%	UINT	0-20000	0	Set at operation	Immediately
2493h	Pn493	Polarity detection command velocity	rpm	UINT	0-1000	50	Set at operation	Immediately
2494h	Pn494	Polarity detection range	0.001rev	UINT	1-65535	250	Set at operation	Immediately
2495h	Pn495	Polarity detection confirmation force command	%	UINT	0-200	100	Set at operation	Immediately
2498h	Pn498	Polarity detection allowable error range	deg	UINT	0-30	10	Set at operation	Immediately
24A0h	Pn4A0	Polarity detection mode selection	—	UINT	0~5	0	Set at operation	Immediately
2502h	Pn502	Rotation detection value	rpm	UINT	1-10000	20	Set at operation	Immediately
2503h	Pn503	Velocity coincidence detection signal output width	rpm	UINT	0-100	10	Set at operation	Immediately
2506h	Pn506	Brake command-servo OFF delay time	10ms	UINT	0~100	20	Set at operation	Immediately
2507h	Pn507	Brake command output velocity value	rpm	UINT	0-10000	100	Set at operation	Immediately
2508h	Pn508	Servo OFF-brake command waiting time	10ms	UINT	1~100	50	Set at operation	Immediately
2509h	Pn509	Momentary power interruption hold time	ms	UINT	20~50000	20	Set at operation	Immediately
251Eh	Pn51E	Excessive position deviation warning value	%	UINT	10-100	100	Set at operation	Immediately
2520h	Pn520	Excessive position deviation alarm value	Unit	UDINT	1-1073741823	524288000	Set at operation	Immediately
2522h	Pn522	Positioning completed width	Unit	UDINT	0-1073741824	5872	Set at operation	Immediately
2524h	Pn524	Near signal width	Unit	UDINT	1-1073741824	1073741824	Set at operation	Immediately
2526h	Pn526	Excessive position deviation alarm value at servo ON	Unit	UDINT	1-1073741823	524288000	Set at operation	Immediately
2528h	Pn528	Excessive position deviation warning value at servo ON	%	UINT	10-100	100	Set at operation	Immediately
2529h	Pn529	Velocity limit value at servo ON	rpm	UINT	0-10000	10000	Set at operation	Immediately
252Bh	Pn52B	Overload warning value	%	UINT	1-100	20	Set at operation	Immediately
252Ch	Pn52C	Base current derating at motor overload detection	%	UINT	10-100	100	Set at stop	After restart
252Dh	Pn52D	Default single-phase power supply	%	UINT	10-100	100	Set at stop	After restart

252Fh	Pn52F	Monitor display at startup	—	UINT	0-4095	4095	Set at operation	Immediately
2530h	Pn530	Program JOG type switch	—	UINT	0-5	0	Set at operation	Immediately
2531h	Pn531	Program JOG travel distance	Unit	UDINT	1-1073741824	32768	Set at operation	Immediately
2533h	Pn533	Program JOG movement velocity	rpm	UINT	1-10000	500	Set at operation	Immediately
2534h	Pn534	Program JOG acceleration/ deceleration time	ms	UINT	2~10000	100	Set at operation	Immediately
2535h	Pn535	Program JOG waiting time	ms	UINT	0-10000	100	Set at operation	Immediately
2536h	Pn536	Program JOG travel count	回	UINT	0-1000	1	Set at operation	Immediately
2560h	Pn560	Residual vibration detection width	0.1%	UINT	1-3000	400	Set at operation	Immediately
2561h	Pn561	Overshoot detection level	%	UINT	0-100	100	Set at operation	Immediately
2562h	Pn562	Viscous friction compensation	0.1%/1000rpm	UINT	0-5000	0	Set at operation	Immediately
2563h	Pn563	Friction compensation percentage	0.1%	UINT	0-1000	0	Set at operation	Immediately
2564h	Pn564	Friction compensation smoothing constant(deceleration)	0.1rpm	UINT	0-1000	0	Set at operation	Immediately
2565h	Pn565	Friction compensation smoothing constant(acceleration)	0.1rpm	UINT	0-1000	0	Set at operation	Immediately
2566h	Pn566	Friction compensation smoothing selection	—	UINT	0~100	0	Set at operation	Immediately
2590h	Pn590	DI1 input signal setting	—	UINT	0-21503	4097	Set at stop	After restart
2591h	Pn591	DI2 input signal setting	—	UINT	0-21503	4098	Set at stop	After restart
2592h	Pn592	DI3 input signal setting	—	UINT	0-21503	4100	Set at stop	After restart
2593h	Pn593	DI4 input signal setting	—	UINT	0-21503	4101	Set at stop	After restart
2594h	Pn594	DI5 input signal setting	—	UINT	0-21503	4099	Set at stop	After restart
2595h	Pn595	DI6 input signal setting	—	UINT	0-21503	8193	Set at stop	After restart
2596h	Pn596	DI7 input signal setting	—	UINT	0-21503	8194	Set at stop	After restart
2597h	Pn597	DI8 input signal setting	—	UINT	0-21503	8196	Set at stop	After restart
2598h	Pn598	DI9 input signal setting	—	UINT	0-21503	8197	Set at stop	After restart
2599h	Pn599	DI10 input signal setting	—	UINT	0-21503	8195	Set at stop	After restart
259Ah	Pn59A	DI11 input signal setting	—	UINT	0-21503	12289	Set at stop	After restart
259Bh	Pn59B	DI12 input signal setting	—	UINT	0-21503	12290	Set at stop	After restart
259Ch	Pn59C	DI13 input signal setting	—	UINT	0-21503	12292	Set at stop	After restart
259Dh	Pn59D	DI14 input signal setting	—	UINT	0-21503	12293	Set at stop	After restart
259Eh	Pn59E	DI15 input signal setting	—	UINT	0-21503	12291	Set at stop	After restart
259Fh	Pn59F	DI16 input signal setting	—	UINT	0-21503	16385	Set at stop	After restart
25A0h	Pn5A0	DI17 input signal setting	—	UINT	0-21503	16386	Set at stop	After restart
25A1h	Pn5A1	DI18 input signal setting	—	UINT	0-21503	16388	Set at stop	After restart
25A2h	Pn5A2	DI19 input signal setting	—	UINT	0-21503	16389	Set at stop	After restart
25A3h	Pn5A3	DI20 input signal setting	—	UINT	0-21503	16387	Set at stop	After restart

25A4h	Pn5A4	DI21 input signal setting	—	UINT	0-21503	20486	Set at stop	After restart
25B0h	Pn5B0	DO1 output signal setting	—	UINT	0-21503	4100	Set at stop	After restart
25B1h	Pn5B1	DO2 output signal setting	—	UINT	0-21503	4116	Set at stop	After restart
25B2h	Pn5B2	DO3 output signal setting	—	UINT	0-21503	8196	Set at stop	After restart
25B3h	Pn5B3	DO4 output signal setting	—	UINT	0-21503	8212	Set at stop	After restart
25B4h	Pn5B4	DO5 output signal setting	—	UINT	0-21503	12292	Set at stop	After restart
25B5h	Pn5B5	DO6 output signal setting	—	UINT	0-21503	12308	Set at stop	After restart
25B6h	Pn5B6	DO7 output signal setting	—	UINT	0-21503	16388	Set at stop	After restart
25B7h	Pn5B7	DO8 output signal setting	—	UINT	0-21503	16404	Set at stop	After restart
25C0h	Pn5C0	Total DI filter parameter (used when common IO filter time is 0)	0.1ms	UINT	0-5000	10	Set at operation	Immediately
25C1h	Pn5C1	DI1 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C2h	Pn5C2	DI2 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C3h	Pn5C3	DI3 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C4h	Pn5C4	DI4 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C5h	Pn5C5	DI5 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C6h	Pn5C6	DI6 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C7h	Pn5C7	DI7 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C8h	Pn5C8	DI8 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25C9h	Pn5C9	DI9 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25CAh	Pn5CA	DI10 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25CBh	Pn5CB	DI11 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25CCh	Pn5CC	DI12 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25CDh	Pn5CD	DI13 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25CEh	Pn5CE	DI14 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25CFh	Pn5CF	DI15 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25D0h	Pn5D0	DI16 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25D1h	Pn5D1	DI17 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25D2h	Pn5D2	DI18 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25D3h	Pn5D3	DI19 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately

25D4h	Pn5D4	DI20 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25D5h	Pn5D5	DI21 filter parameter	0.1ms	UINT	0~5000	0	Set at operation	Immediately
25F6h	Pn5F6	Lifting value at BK	0.0001rev /0.01mm	INT	-25000~25000	0	Set at operation	Immediately
25F7h	Pn5F7	Maximum lifting velocity at BK	1rpm	UINT	0~65535	0	Set at operation	Immediately
25F8h	Pn5F8	Lifting acceleration and deceleration time at BK	1ms	UINT	0~65535	0	Set at operation	Immediately
2600h	Pn600	Brake resistance capacity * 1	10W	UINT	0-65535	0	Set at operation	Immediately
2601h	Pn601	DB resistance capacity	10W	UINT	0-65535	0	Set at stop	After restart
2602h	Pn602	Motor type selection	—	UINT	0-256	0	Set at stop	After restart
2603h	Pn603	Natural frequency of motor selection	—	UINT	0-65535	0	Set at stop	After restart
2605h	Pn605	First Encoder Configuration	—	UINT	0-65535	0	Set at stop	After restart
2609h	Pn609	Application-specific function selection switch 609	—	UINT	0-65535	0	Set at stop	After restart
260Dh	Pn60D	Alarm delay disable time	ms	UINT	0-500	0	Set at stop	After restart
260Eh	Pn60E	User torque overload threshold	%	UINT	0-65535	0	Set at stop	After restart
260Fh	Pn60F	User torque overload time	10ms	UINT	1000	0	Set at stop	After restart
2610h	Pn610	Position comparison output function	—	UINT	0-3	0	Set at stop	After restart
2611h	Pn611	First set position	Unit	DINT	-1073741824 ~1073741823	0	Set at operation	Immediately
2613h	Pn613	Second set position	Unit	DINT	-1073741824 ~1073741823	0	Set at operation	Immediately
2615h	Pn615	Third set position	Unit	DINT	-1073741824 ~1073741823	0	Set at operation	Immediately
2617h	Pn617	Fourth set position	Unit	DINT	-1073741824 ~1073741823	0	Set at operation	Immediately
2619h	Pn619	Effective time of the first set position output signal	ms	UINT	0-65535	0	Set at operation	Immediately
261Ah	Pn61A	Effective time of the second set position output signal	ms	UINT	0-65535	0	Set at operation	Immediately
261Bh	Pn61B	Effective time of the third set position output signal	ms	UINT	0-65535	0	Set at operation	Immediately
261Ch	Pn61C	Effective time of the fourth set position output signal	ms	UINT	0-65535	0	Set at operation	Immediately
261Dh	Pn61D	Position comparison delay compensation	0.1us	UINT	0~625	0	Set at stop	After restart
261Fh	Pn61F	Application Function Selection61F	—	UINT	0-65535	0	Set at stop	After restart

2630h	Pn630	Resistance of external brake resistor	10mΩ	UINT	0~65535	0	Set at stop	After restart
2631h	Pn631	Gravity compensation function switch	—	UINT	0-2	0	Set at operation	Immediately
2640h	Pn640	Black box function configuration	—	UINT	0-65535	0	Set at stop	After restart
2641h	Pn641	Black box latch alarm code setting	—	UINT	0-65535	0	Set at stop	After restart
2645h	Pn645	The variable trace function tracks the 16-bit variable actual address assignment	-	UDINT	0~4294967295	—	Set at operation	Immediately
2646h	Pn646	The variable trace function tracks the actual address assignment of a 32-bit variable	-	UDINT	0~4294967295	—	Set at operation	Immediately
2660h	Pn660	Current command setting	—	UINT	0-10000	0	Set at stop	After restart
2661h	Pn661	Phase angle setting	—	UINT	0-500	0	Set at stop	After restart
266Fh	Pn66F	Online inertia update time	min	UINT	0-65535	0	Set at operation	Immediately
2670h	Pn670	Online inertia identification setting	—	UINT	0-3	0	Set at stop	After restart
2676h	Pn676	Internal brake configuration	—	UINT	0-8203	0	Set at stop	After restart
2678h	Pn678	Self-adjusting rigid setting	—	UINT	0-41	4	Set at operation	Immediately
2679h	Pn679	Self-adjusting mode	—	UINT	0-6	0	Set at operation	Immediately
267Ah	Pn67A	Self-adjusting vibration treatment time	s	UINT	0-65535	300	Set at operation	Immediately
267Fh	Pn67F	Probe delay compensation	0.1us	INT	-32768~32767	0	Set at operation	Immediately
26A8h	Pn6A8	Manual BK control	—	UINT	0-1	0	Set at operation	Immediately
26A9h	Pn6A9	Collision detection torque	1%	UINT	0-300	0	Set at stop	After restart
26AAh	Pn6AA	Collision detection time	ms	UINT	0-5000	1	Set at stop	After restart
26B0h	Pn6B0	Advanced auto-tune one-touch control (Fn202)	—	UINT	0-20	0	Set at operation	Immediately
26B1h	Pn6B1	Advanced auto-tune one-touch control (Fn201)	—	UINT	0-20	0	Set at operation	Immediately
26B2h	Pn6B2	Travel distance of advanced automatic tuning	-	INT	-32768~32767	0	Set at operation	Immediately
26B3h	Pn6B3	Advanced auto-tuning initial gain level	—	UINT	0-5	2	Set at operation	Immediately
26B4h	Pn6B4	Advanced auto-tuning initial inertia level	—	UINT	0-3	2	Set at operation	Immediately
26B5h	Pn6B5	Advanced auto-tuning initial positioning accuracy	—	UINT	0-9	4	Set at operation	Immediately

26B6h	Pn6B6	Percent of Advanced Autotune Gain Results Saved	1%	UINT	1-100	70	Set at operation	Immediately
26B7h	Pn6B7	Advanced auto-tune configuration function	—	UINT	0-4396	1	Set at operation	Immediately
26B8h	Pn6B8	Advanced auto-tuning_ start of motion interval (Negative limit)	Unit	DINT	-2147483648 ~2147483647	0	Set at operation	Immediately
26BAh	Pn6BA	Advanced auto-tuning_ end of motion interval (Positive limit)	Unit	DINT	-2147483648 ~2147483647	0	Set at operation	Immediately
26C0h	Pn6C0	Gantry function switch	—	UINT	0~17	16	Set at stop	After restart
26C1h	Pn6C1	Gantry slave shaft function switch	—	UINT	0-17	0	Set at operation	Immediately
26C2h	Pn6C2	Gantry coordinated stop mode	—	UINT	0-2	0	Set at operation	Immediately
26C3h	Pn6C3	Warning value of excessive position deviation between gantry axes	1%	UINT	10-100	100	Set at operation	Immediately
26C4h	Pn6C4	Alarm value for excessive position deviation between gantry axes	Uint	UINT	0-1073741823	1048576	Set at operation	Immediately
26C5h	Pn6C5	Alarm value for excessive differential torque between gantry axes	1%	UINT	0~6000	1000	Set at operation	Immediately
26C6h	Pn6C6	Gantry coordinated stop speed FF feedforward	1%	UINT	0-100	0	Set at operation	Immediately
26C7h	Pn6C7	Proportional gain of gantry synchronous position loop	0.1/s	UINT	10-20000	400	Set at operation	Immediately
26C8h	Pn6C8	Integral time of synchronous position loop of gantry	0.1ms	UINT	0-50000	2000	Set at operation	Immediately
26C9h	Pn6C9	Gantry synchronous velocity limiting	0.1%	UINT	0-1000	20	Set at operation	Immediately
26CAh	Pn6CA	Differential velocity limit between gantry coordinated stop axes	rpm	UINT	0-3000	300	Set at operation	Immediately
26CBh	Pn6CB	Gantry coordination stop completion speed threshold	rpm	UINT	0-1000	15	Set at operation	Immediately
2776h	Pn776	System position 31:00 upper limit L	—	UDINT	0-4294967296	0	Set at operation	Immediately
2778h	Pn778	System position 63:32 upper limit H	—	UDINT	0-4294967296	0	Set at operation	Immediately
277Fh	Pn77F	Homing timeout time	100ms	UDINT	0~4294967295	10000	Set at operation	Immediately
2781h	Pn781	Function selection switch 0	—	UINT	0~4369	0	Set at operation	Immediately

2785h	Pn785	Synchronous frame error count limit	—	UDINT	2-32767	9	Set at operation	Immediately
2786h	Pn786	Node ID address setting	—	UINT	0-65535	0	Set at operation	Immediately
2787h	Pn787	Function selection switch 1	—	UINT	0~16	0	Set at operation	Immediately
2788h	Pn788	Low 32 bits of analog-digital homing offset position	—	UDINT	0-4294967296	0	Set at operation	Immediately
2789h	Pn789	High 32 bits of analog-digital homing offset position	—	UDINT	0-4294967296	0	Set at operation	Immediately
278Ah	Pn78A	Setting of upper limit value of analog-digital function position	—	UDINT	0~4294967295	0	Set at stop	After restart
278Ch	Pn78C	6091-Electronic gear ratio numerator	—	UDINT	1~4294967295	1	Set at operation	Immediately
278Eh	Pn78E	6091-Electronic gear ratio denominator	—	UDINT	1~4294967295	1	Set at operation	Immediately
2790h	Pn790	EtherCAT function conversion switch 0	—	UINT	0~8448	0	Set at operation	Immediately
2793h	Pn793	EtherCAT function conversion switch 3	—	UINT	0~1	0	Set at operation	Immediately

11.4 Object dictionary 6000H group common parameter list

Index	Sub-In-dex	Type	Name	Data Type	Access type	Mapping type	Unit
603Fh		VAR	Error Code	UINT	ro	T	—
6040h		VAR	Control Word	UINT	rw	R	—
6041h		VAR	Status word	UINT	ro	T	—
605Ah		VAR	Selection of fast shutdown mode	INT	rw	R	—
605Dh		VAR	Selection of pause mode	INT	rw	R	—
605Eh		VAR	Fault reaction option code	INT	rw	R	—
6060h		VAR	control mode	SINT	rw	R	—
6061h		VAR	Control mode display	SINT	ro	T	—
6062h		VAR	User position command	DINT	ro	T	User Unit
6063h		VAR	Motor position feedback	DINT	ro	T	Encoder Unit
6064h		VAR	User position feedback	DINT	ro	T	User Unit
6065h		VAR	Threshold value of user position bias	UDINT	rw	R	User Unit
6066h		VAR	Position bias Time Window	UINT	rw	R	ms
6067h		VAR	Position reached threshold	UDINT	rw	R	User Unit
6068h		VAR	Position arrival time	UINT	rw	R	ms
606Bh		VAR	User velocity Command Value	DINT	ro	T	User Instruction
606Ch		VAR	User actual velocity feedback	DINT	ro	T	User Instruction
606Dh		VAR	Velocity arrival threshold	UINT	rw	R	User Instruction
606Eh		VAR	Velocity arrival time	UINT	rw	R	ms
6071h		VAR	Target torque value	INT	rw	R	0.1%
6072h		VAR	Max. torque	UINT	rw	R	0.1%

6074h		VAR	User defined torque value	INT	ro	T	0.1%
6076h		VAR	Motor velocity torque	UDINT	ro	T	—
6077h		VAR	Actual torque feedback	INT	ro	T	0.1%
607Ah		VAR	Target position value	DINT	rw	R	User Instruction
607Ch		VAR	Origin Offset	DINT	rw	R	User Instruction
607Dh	1	ARRAY	Software limit: minimum position limit	DINT	rw	R	User Instruction
	2	ARRAY	Software limit: maximum position limit	DINT	rw	R	User Instruction
607Eh		VAR	Polarity of instruction	USINT	rw	R	—
607Fh		VAR	Max Contour Velocity	UDINT	rw	T	User Instruction
6080h		VAR	Maximum Motor Velocity	UDINT	rw	T	rpm
6081h		VAR	Velocity of contour	UDINT	rw	R	User Instruction/s
6083h		VAR	Acceleration of contour	UDINT	rw	R	User Instruction/s2
6084h		VAR	Deceleration of contour	UDINT	rw	R	User Instruction/s2
6085h		VAR	Quick Stop Deceleration	UDINT	rw	R	User Instruction/s2
6087h		VAR	Torque Ramp	UDINT	rw	R	0.1%/s
6091h	1	ARRAY	Electronic gear ratio: Numerator	UDINT	rw	R	—
	2	ARRAY	Electronic gear ratio: Denominator	UDINT	rw	R	—
6098h		VAR	Homing mode	SINT	rw	R	—
6099h	1	ARRAY	Velocity of search deceleration point signal in homing mode	UDINT	rw	R	User Instruction/s
	2	ARRAY	Velocity of search origin switch signal in homing mode	UDINT	rw	R	User Instruction/s
609Ah		VAR	Homing acceleration	UDINT	rw	R	User Instruction/s2
60B0h		VAR	Position bias	DINT	rw	R	User Instruction
60B1h		VAR	Velocity offset	DINT	rw	R	User Instruction/s
60B2h		VAR	Torque offset	INT	rw	R	0.1%
60B8h		VAR	Probe function	UINT	rw	R	—
60B9h		VAR	Probe status word	UINT	ro	T	—
60BAh		VAR	Probe 1 rising edge position feedback	DINT	ro	T	—
60BBh		VAR	Probe 1 falling edge position feedback	DINT	ro	T	—
60BCh		VAR	Probe 2 Rising Edge Position Feedback	DINT	ro	T	—
60BDh		VAR	Probe 2 falling edge position feedback	DINT	ro	T	—
60C0h		VAR	Interpolation sub-mode selection	INT	rw	R	—
60C1h		VAR	Interpolation data recording	UDINT	rw	R	—
60C2h	1	ARRAY	Interpolation time period	USINT	rw	R	—
	2	ARRAY	Interpolation time point	SINT	rw	R	—
60D5h		VAR	Probe 1 rising edge count value	UINT	ro	T	—
60D6h		VAR	Probe 1 falling edge count value	UINT	ro	T	—
60D7h		VAR	Probe 2 rising edge count value	UINT	ro	T	—
60D8h		VAR	Probe 2 falling edge count value	UINT	ro	T	—
60E0h		VAR	Forward Maximum Torque Limit	UINT	rw	R	0.1%
60E1h		VAR	Reverse Maximum Torque Limit	UINT	rw	R	0.1%
60F4h		VAR	User position bias	DINT	ro	T	User Instruction
60FCh		VAR	Motor position command feedback	DINT	ro	T	User Instruction
60FDh		VAR	DI input status	UDINT	ro	T	—
60FEh	1	ARRAY	DO output Status	UDINT	rw	R	—
	2	ARRAY	Bit mask	UDINT	rw	R	—
60FFh		VAR	Target velocity	DINT	rw	R	User Instruction/s
6502h		VAR	Supporting servo operation mode	UDINT	ro	T	—

11.5 Detailed description of 6000H object dictionary

Object $213F_h$: Servo Drive Internal Error Code			
Object description		Object entry description	
Attribute	Value	Attribute	Value
Index	$213F_h$	Sub-index	00_h
Name	Error Code	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint32	Data range	0~4294967295
Operation mode	—	Default value	0
Displays servo drive error code, consistent with the error code numeric value shown on the panel.			

Object $603F_h$: Error code			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	$603F_h$	Sub-index	00_h
Name	Error Code	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	ALL	Default value	0
Displays protocol fault code.			
Note: This is not the servo internal fault alarm code. For servo fault alarm codes, refer to 213Fh.			

Object 6040_h: Control word			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6040_h	Sub-index	00_h
Name	Control word	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	ALL	Default value	0

Used for enabling, clearing alarms, and initiating commanded operations in various operation modes, etc.

bit	Definition	
0	Servo ready	0: invalid 1: valid
1	Main circuit power on	0: invalid 1: valid
2	Quick stop	0: invalid 1: valid
3	Servo operation	0: invalid 1: valid
4	Operation mode dependent	
5	Operation mode dependent	
6	Operation mode dependent	
7	Fault rese	Rising edge valid (when this bit is set to 1, other control commands are invalid)
8	Halt	0: invalid 1: valid
9~15	Reserved	

Object 6041_h: Status word			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6041_h	Sub-index	00_h
Name	Status word	Access type	ro

Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	ALL	Default value	0

bit	Definition	
0	Servo fault-free	0: Invalid 1: Valid. When valid, indicates the servo can be enabled
1	Waiting for servo enable	0: Invalid 1: Valid. When valid, indicates the servo can be enabled
2	Servo operation status	0: Not running 1: Running. When valid, indicates the servo is enabled
3	Servo fault	0: Fault present 1: No fault
4	Main circuit voltage on	0: Not on 1: On. When valid, indicates the servo can be enabled
5	Quick stop	0: Quick stop invalid 1: Quick stop valid
6	Servo disabled	0: Invalid 1: Valid. When valid, indicates the servo cannot be enabled
7	Warning	0: No warning 1: Warning present
8	Manufacturer-specific	Not used
9	Remote control	0: Invalid 1: Valid. When valid, indicates the control word is active
10	Position reached	60400010h bit8（Halt）=0, 0: Position not reached 1: Position reached 60400010h bit8（Halt）=1, 0: Decelerating 1: Speed is zero
11	Software internal position limit exceeded	0: Soft limit not reached 1: Soft limit reached
12	Operation mode dependent	0: Not following target position 1: Following target position
13	Operation mode dependent	0: No position deviation alarm 1: Position deviation alarm occurred
14	Manufacturer-specific	Not used
15	Homing completed	0: Invalid 1: Homing completed For absolute systems, after Pn781.3=1, the value of bit15 will be stored after successful homing (power-down retention)

Note: Assigning values to individual bits of the status word is meaningless; they must form specific control instructions together with other bits. The following are basic status word examples (X represents any value).

Initialization failure (not ready to switch on): XXXX XXXX X0XX 0000	Servo start failure (switch on disable): XXXX XXXX X0XX 0000
Servo ready (ready to switch on): XXXX XXXX X01X 0001	Servo start (switch on): XXXX XXXX X01X 0011
Quick stop (quick stop active): XXXX XXXX X00X 0111	Servo operation enable (operation enable): XXXX XXXX X01X 0111
Servo fault (fault): XXXX XXXX X0XX 1000	Fault reaction active (fault reaction active): XXXX XXXX X0XX 1111

Object 605A$_h$: Quick stop mode selection

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	605A$_h$	Sub-index	00$_h$
Name	Quick stop mode selection	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint16	Data range	0~7
Operation mode	ALL	Default value	2

When bit 2 of control word 6040h is 0, the quick stop mode is determined by the setting of object 605Ah.

Set value	Stop mode
0	Coast to stop, and remain free.
1	Ramp stop with deceleration from object 6084, and remain free.
2	Emergency ramp stop with emergency deceleration from object 6085, and remain free.
3	Maximum torque braking stop, and remain free.
4	Not defined, and cannot be set.
5	Ramp stop with deceleration from object 6084, and remain position locked.
6	Emergency ramp stop with emergency deceleration from object 6085, and remain position locked.
7	Maximum torque braking stop, and remain position locked.

Object 605Dh: Halt mode selection			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	$605D_h$	Sub-index	00_h
Name	Halt mode selection	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint16	Data range	0~4
Operation mode	ALL	Default value	1

When bit 8 of the control word 6040h is active (halt function enabled), the halt behavior is determined by object 605Dh.

Set value	Stop mode
0	Not supported, cannot be set. If forced to set, the halt behavior is unpredictable.
1	Decelerate using the deceleration time from object 6084h, remain position locked.
2	Decelerate using the deceleration time from object 6085h, remain position locked.

When decelerating with 6084h: in homing mode, the deceleration time from object 609Ah is used; in torque mode, the deceleration time from object 6087h is used.

Object 605Eh: Fault reaction option code			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	$605E_h$	Sub-index	00_h
Name	Fault reaction option code	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint16	Data range	0~0
Operation mode	ALL	Default value	0

Fault reaction option code

Object 6060h: Control mode			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6060_h	Sub-index	00_h
Name	Control mode	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint8	Data range	0~10
Operation mode	ALL	Default value	0

Selects the control mode for operation.

Value	Definition	Remarks
0	Reserved	Reserved
1	Profile position mode (PP)	Refer to "5.7 Profile Position Mode (PP)".
2	Velocity mode	Not supported.
3	Profile velocity mode (PV)	Refer to "5.8 Profile Position Mode (PV)".
4	Profile torque mode (PT)	Refer to "5.9 Profile Position Mode (PT)".
5	Reserved	Reserved
6	Homing mode (HM)	Refer to "5.10 Profile Position Mode (HM)".
7	Interpolated position mode (IP)	Not supported.
8	Cyclic synchronous position mode (CSP)	Refer to “5.11 Profile Position Mode（CSP）”
9	Cyclic synchronous velocity mode (CSV)	Refer to “5.12 Profile Position Mode（CSV）”
10	Cyclic synchronous torque mode (CST)	Refer to “5.13 Profile Position Mode（CST）”

Object 6061h: Control mode display			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6061_h	Sub-index	00_h
Name	Control mode display	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint8	Data range	0~10
Operation mode	ALL	Default value	0

Selects the control mode for operation.

Value	Definition	Remarks
0	Reserved	Reserved
1	Profile position mode (PP)	Refer to "5.7 Profile Position Mode (PP)".
2	Velocity mode	Not supported.
3	Profile velocity mode (PV)	Refer to "5.8 Profile Position Mode (PV)".
4	Profile torque mode (PT)	Refer to "5.9 Profile Position Mode (PT)".
5	Reserved	Reserved
6	Homing mode (HM)	Refer to "5.10 Profile Position Mode (HM)".
7	Interpolated position mode (IP)	Not supported.
8	Cyclic synchronous position mode (CSP)	Refer to “5.11 Profile Position Mode（CSP）”
9	Cyclic synchronous velocity mode (CSV)	Refer to “5.12 Profile Position Mode（CSV）”
10	Cyclic synchronous torque mode (CST)	Refer to “5.13 Profile Position Mode（CST）”

Object 6062h: User position command			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6062_h	Sub-index	00_h
Name	User position command	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	PP、HM、CSP	Default value	0

Reflects real-time position command (user units).

Object 6063h: Motor position feedback			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6063_h	Sub-index	00_h
Name	Motor position feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	ALL	Default value	0

Reflects real-time motor absolute position feedback.

Object 6064h: User position feedback			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6064_h	Sub-index	00_h
Name	User position feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO

Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	ALL	Default value	0
Reflects real-time user absolute position feedback.			

Object 6065_h: User position deviation excess threshold			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6065_h	Sub-index	00_h
Name	User position deviation excess threshold	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	PP/CSP/HM	Default value	0
When the difference between the user position command (from object 6062h) and the user position feedback (from object 6064h) exceeds ±6065h, an excessive position deviation fault occurs.			

Object 6066_h: Position bias time window			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6066_h	Sub-index	00_h
Name	Position bias time window	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0-65535
Operation mode	PP/CSP/HM	Default value	0
Position bias time window			

Object 6067_h: Position arrival threshold			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6067_h	Sub-index	00_h
Name	Position arrival threshold	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	PP/CSP/HM	Default value	50
When the difference between the user position command (from object 6062h) and the user actual position feedback (from object 6064h) is within ±6067h and the duration reaches 6068h, position arrival is recognized. In profile position mode, bit 10 of status word 6041h is set to 1. This flag is valid only when servo enable is active in profile position mode, otherwise it is invalid.			

Object 6068_h: Position arrival time			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6068_h	Sub-index	00_h
Name	Position arrival time	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	PP/CSP/HM	Default value	0
When the difference between the user position command (from object 6062h) and the user actual position feedback (from object 6064h) is within ±6067h and the duration reaches 6068h, position arrival is recognized. In profile position mode, bit 10 of status word 6041h is set to 1. This flag is valid only when servo enable is active in profile position mode, otherwise it is invalid.			

Object 606B$_h$: User velocity command value			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	606B$_h$	Sub-index	00$_h$
Name	User velocity command value	Access type	ro
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	ALL	Default value	0
Reflect user velocity command value			

Object 606C$_h$: User actual speed feedback			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	606C$_h$	Sub-index	00$_h$
Name	User actual speed feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	ALL	Default value	0
Reflects the user actual speed feedback value.			

Object 606D$_h$: Speed arrival threshold			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	606D$_h$	Sub-index	00$_h$
Name	Speed arrival threshold	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	PV/CSV	Default value	0
When the difference between the target speed (from object 60FFh) and the user actual speed (from object 606Ch) is within ±606Dh and the duration reaches 606Eh, speed arrival is recognized. In profile velocity mode, bit 10 of status word 6041h is set to 1. This flag is valid only when servo enable is active in profile velocity mode, otherwise it is invalid.			

Object 606E$_h$: Speed arrival time			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	606E$_h$	Sub-index	00$_h$
Name	Speed arrival time	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	PV/CSV	Default value	0
When the difference between the target speed (from object 60FFh) and the user actual speed (from object 606Ch) is within ±606Dh and the duration reaches 606Eh, speed arrival is recognized. In profile velocity mode, bit 10 of status word 6041h is set to 1. This flag is only valid when servo enable is active in profile velocity mode, otherwise it has no meaning.			

Object 6071$_h$: Torque target value			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6071$_h$	Sub-index	00$_h$

Name	Torque target value	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint16	Data range	-32768~32767
Operation mode	PT/CST	Default value	0

Torque reference in PT/CST mode, unit 0.1%.

100% corresponds to 1 times the motor rated torque.

Object 6072h: Maximum torque

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6072h	Sub-index	00h
Name	Maximum torque	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	ALL	Default value	8000

Maximum torque command, unit 0.1%.

Sets the maximum torque of the motor.

Object 6074h: User defined torque value

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6074h	Sub-index	00h
Name	User defined torque value	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint16	Data range	-32768~32767
Operation mode	ALL	Default value	0

Reflect the real-time user given torque value; 100% corresponds to 1 times the motor rated torque.

Object 6076h: Motor velocity torque

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6076h	Sub-index	00h
Name	Motor velocity torque	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	ALL	Default value	0

Motor velocity torque

Object 6077h: Actual torque feedback

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6077h	Sub-index	00h
Name	Actual torque feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint16	Data range	-32768~32767
Operation mode	ALL	Default value	0

Reflects real-time servo internal torque feedback. 100% corresponds to 1 times the motor rated torque.

Object 607A$_h$: Target positionValue			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	607A$_h$	Sub-index	00$_h$
Signal	Target positionValue	Access	rw
Data structure	Variable	PDO mapping type	RxPDO
Data type	Sint32	Data range	-2147483648~2147483647
Control mode	PP/CSP	Default value	0

Sets the servo target position in profile position mode and cyclic synchronous position mode;
When using absolute commands, after positioning is complete, the user absolute position (from object 6064h) equals 607Ah.
When using relative commands, after positioning is complete, the user displacement increment (from object 607Ah) equals 607Ah.

Object 607C$_h$: Home offset			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	607C$_h$	Sub-index	00$_h$
Name	Home offset	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	HM	Default value	0

After homing is complete, the motor stops at the mechanical home position. By configuring object 607Ch, the relationship between the mechanical home and mechanical zero point is defined as: Mechanical Home = Mechanical Zero Point + 607Ch (Home Offset). When 607Ch = 0,the mechanical home coincides with the mechanical zero point.
The home offset takes effect under these conditions: the drive is powered and running, homing has been completed, and bit 15 of status word 6041h is set to 1.
In homing mode, the host controller first selects the homing method (object 6098h), configures homing speeds (objects 6099-1h and 6099-2h),and sets homing acceleration (object 609Ah). After sending the homing trigger signal, the servo automatically locates the mechanical home per the settings and establishes the relative position between the mechanical home and the mechanical zero point. The servo drive internally manages position, speed, and torque control.
Alternatively, using homing method 35, the current position can be defined as the mechanical home. After triggering homing (control word 6040h: 0x0F → 0x1F), the user current position (from object 6064h) equals 607Ch (Note: the motor shaft does not physically rotate).
Mechanical home: A fixed physical position on the machine (e.g., aligned with home switches, limit switches, or motor Z signals). Mechanical Zero Point: The absolute zero position on the machine (e.g., encoder zero reference).

Object 607D$_h$: Software limit			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	607D$_h$	Sub-index	00$_h$
Name	Number of software limit sub-indexes	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint8	Data range	0~512
Operation mode	ALL	Default value	2

Objects description	Objects entry description

Attribute	Value	Attribute	Value
Index	$607D_h$	Sub-index	01_h
Name	Minimum software position limit	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	ALL	Default value	-2147483648

Software limit function:

Pn781 Bit 0 is the software limit switch:

0: Software limits are disabled;

1: The software limit function is enabled when the drive is powered on;

This parameter sets the minimum software absolute position limit. When this parameter is set to -2147483648, it indicates no negative direction limit. The minimum software absolute position limit equals (object 607D-01h).

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	$607D_h$	Sub-index	02_h
Name	Maximum software position limit	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	ALL	Default value	-2147483648

Software limit function:

Pn781 Bit 0 is the software limit switch:

0: Software limits disabled;

1: The software limit function is enabled when the drive powers up;

This parameter sets the maximum software absolute position limit. When set to 2147483647, it indicates no positive direction limit. The maximum software absolute position limit equals (object 607D-02h).

Object $607E_h$: Polarity of commands

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	$607E_h$	Sub-index	00_h
Name	Polarity of commands	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint8	Data range	0~255
Operation mode	ALL	Default value	0

Set the polarity for torque commands, torque feedback, position commands, position feedback, speed commands, speed feedback, and the external limit signal bits (bit1 (POT) of object 60FDh-00h, bit2 (NOT) of object 60FDh-01h). These settings only take effect after the servo state machine transitions back through the Init-PreOP-SafeOP-OP sequence to state 0.

During operation, the speed, position, and torque polarities must be set to 0 (with Bits 5-7 all 0) or 224 (with Bits 5-7 all 1).

Bit	Definition
0	Reserved
1	Reserved
2	Reserved
3	Reserved
4	Reserved
5	Multiplies torque command 6071h/60B2h × (-1) and torque feedback 6074h/6077h × (-1), reversing motor rotation direction
6	Multiplies speed command 60FFh/60B1h × (-1) and speed feedback 606Bh/606Bh × (-1), reversing motor rotation direction
7	Multiplies position command 607Ah/60B0h × (-1) and position feedback 6062h/6064h × (-1), reversing motor rotation direction

Object 607F$_h$: Maximum profile speed			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	607F$_h$	Sub-index	00$_h$
Name	Maximum profile speed	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	ALL	Default value	2147483647
Sets the maximum user operating speed, primarily serving as a protective limit.			

Object 6080$_h$: Maximum motor speed			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6080$_h$	Sub-index	00$_h$
Name	Maximum motor speed	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	ALL	Default value	10000
Sets the maximum motor operating speed to protect the motor, and also serves as the maximum speed limit in CST mode.			

Object 6081$_h$: Profile speed			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6081$_h$	Sub-index	00$_h$
Name	Profile speed	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	PP	Default value	0
Speed during constant velocity operation of displacement commands in profile position mode.			

Object 6083$_h$: Profile acceleration			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6083$_h$	Sub-index	00$_h$
Name	Profile acceleration	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	PP/PV	Default value	10485760
User command units/S^2			

Object 6084$_h$: Profile deceleration			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6084$_h$	Sub-index	00$_h$
Name	Profile deceleration	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295

Operation mode	PP/PV/CSP/CSV	Default value	10485760
User command units/S^2			

Object 6085_h: Quick stop deceleration			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6085_h	Sub-index	00_h
Name	Quick stop deceleration	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	PP/PV/CSP/CSV	Default value	10485760
User command units/S^2			

Object 6087_h: Torque ramp			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6087_h	Sub-index	00_h
Name	Torque ramp	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	PT/CST	Default value	1000
Torque command acceleration in profile torque mode, defined as the incremental torque command per second (unit: 1‰ /s).			

Object 6091_h: Electronic gear ratio			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	6091_h	Sub-index	00_h
Name	Number of electronic gear ratio indexes	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint8	Data range	0~512
Operation mode	ALL	Default value	2
Attribute	Value	Attribute	Value
Index	6091_h	Sub-index	01_h
Name	Electronic gear ratio: Numerator	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	1-4294967295
Operation mode	ALL	Default value	1
Attribute	Value	Attribute	Value
Index	6091_h	Sub-index	02_h
Name	Electronic gear ratio: Denominator	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	1-4294967295
Operation mode	ALL	Default value	1
Servo electronic gear ratio= object 6091h=object 6091h: 01 (motor revolutions) / object 6091h: 02 (drive shaft revolutions)			

Object 6098h: Homing mode			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6098h	Sub-index	00h
Name	Homing mode	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint8	Data range	0~35
Operation mode	Hm	Default value	0
In the CANopen protocol, 31 homing methods are defined based on home switch signals, limit switch signals, and encoder Z signals.			

Object 6099h: Homing speed			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6099h	Sub-index	01h
Name	Number of sub-indexes	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	HM	Default value	1048576

Attribute	**Value**	**Attribute**	**Value**
Index	6099h	Sub-index:	02h
Name	Search for deceleration point signal speed during homing mode	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	HM	Default value	1048576

Attribute	**Value**	**Attribute**	**Value**
Index	6099h	Sub-index:	02h
Name	Search for home switch signal speed during homing mode	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	HM	Default value	524288

Object 609Ah: Homing acceleration			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	609Ah	Sub-index	00h
Name	Homing acceleration	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	HM	Default value	10485760
User command units/S^2			

Object 60B0h: Position offset			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	60B0h	Sub-index	00h
Name	Position offset	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	CSP	Default value	0
Sets the position offset in Cyclic Synchronous Position Mode. Servo target position = 607Ah + 60B0h.			

Object 60B1h: Speed offset			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	60B1h	Sub-index	00h
Name	Speed offset	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	CSP/CSV	Default value	0
Sets the speed offset in Cyclic Synchronous Velocity Mode. Servo target speed = (object 60FFh + object 60B1h).			

Object 60B2h: Torque offset			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	60B2h	Sub-index	00h
Name	Torque offset	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint16	Data range	-32768~32767
Operation mode	CSP/CSV/CST	Default value	0
Sets the torque offset in Cyclic Synchronous Torque Mode. Servo target torque = (object 6071h + object 60B2h).			

Object 60B8h: Probe function			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	60B8h	Sub-index	00h
Name	Probe function	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	—	Default value	0

Bit	Definition
0	Probe 1 enable 0: Disable Probe 1 function. 1: Enable Probe 1 function.
1	Probe 1 trigger mode 0: Single trigger 1: Continuous trigger
2	Probe 1 trigger signal selection 0: DI4 trigger 1: Z signal trigger
3	Reserved
4	Probe 1 rising edge latch 0: Rising edge latching not executed for Probe 1. 1: Rising edge latching executed for Probe 1.
5	Probe 1 falling edge latch 0: Falling edge latching not executed for Probe 1. 1: Falling edge latching executed for Probe 1.
6	Reserved
7	Reserved
8	Probe 2 enable 0: Disable Probe 2 function. 1: Enable Probe 2 function.
9	Probe 2 trigger mode 0: Single trigger 1: Continuous trigger
10	Probe 2 trigger signal selection 0: DI4 trigger 1: Z signal trigger
11	Reserved
12	Probe 2 rising edge latch 0: Rising edge latching not executed for Probe 2. 1: Rising edge latching executed for Probe 2.
13	Probe 2 falling edge latch 0: Falling edge latching not executed for Probe 2. 1: Falling edge latching executed for Probe 2.
14	Reserved
15	Reserved

Object 60B9h: Probe status word			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	60B9h	Sub-index	00h
Name	Probe status word	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	—	Default value	0

Bit	Description
0	Probe 1 enable 0: Disable Probe 1 function. 1: Enable Probe 1 function.
1	Probe 1 rising edge latch 0: Rising edge latching not executed for Probe 1. 1: Rising edge latching executed for Probe 1.
2	Probe 1 falling edge latch 0: Falling edge latching not executed for Probe 1. 1: Falling edge latching executed for Probe 1.
3	Reserved
4	Reserved
5	Reserved
6	Probe 1 trigger signal selection 0: DI4 trigger 1: Z signal trigger
7	Probe 1 trigger DI level selection 0: DI4 low level trigger 1: DI4 high level trigger
8	Probe 2 enable 0: Disable Probe 2 function. 1: Enable Probe 2 function.
9	Probe 2 rising edge latch 0: Rising edge latching not executed for Probe 2. 1: Rising edge latching executed for Probe 2.
10	Probe 2 falling edge latch 0: Falling edge latching not executed for Probe 2. 1: Falling edge latching executed for Probe 2.
11	Reserved
12	Reserved
13	Reserved
14	Probe 2 trigger signal selection 0: DI5 trigger 1: Z signal trigger
15	Probe 2 trigger DI level selection 0: DI5 low level trigger 1: DI5 high level trigger

Object 60BAh: Probe 1 rising edge position feedback			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	60BAh	Sub-index	00h
Name	Probe 1 rising edge position feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	—	Default value	0
Records the position feedback (command units, 6064h) when Probe 1 rising edge is active.			

Object 60BBh: Probe 1 falling edge position feedback			
Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**

Index	$60BB_h$	Sub-index	00_h
Name	Probe 1 falling edge position feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	—	Default value	0
Records the position feedback (command units, 6064h) when Probe 1 falling edge is active.			

Object $60BC_h$: Probe 2 rising edge position feedback			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	$60BC_h$	Sub-index	00_h
Name	Probe 2 rising edge position feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	—	Default value	0
Records the position feedback (command units, 6064h) when Probe 2 rising edge is active.			

Object $60BD_h$: Probe 2 falling edge position feedback			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	$60BD_h$	Sub-index	00_h
Name	Probe 2 falling edge position feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	—	Default value	0
Records the position feedback (command units, 6064h) when Probe 2 falling edge is active.			

Object $60C0_h$: Interpolation sub-mode selection			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	$60C0_h$	Sub-index	00_h
Name	Interpolation sub-mode selection	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint16	Data range	-3~0
Operation mode	—	Default value	0
Interpolation sub-mode selection			

Object $60C1_h$: Interpolation data recording			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	$60C1_h$	Sub-index	00_h
Name	Interpolation data recording	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0~4294967295

Operation mode	—	Default value	0
Interpolation data recording			

Object 60C2h: Interpolation time period			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	60C2h	Sub-index	01h
Name	Interpolation time period	Access type	rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint8	Data range	1~250
Operation mode	—	Default value	125
Interpolation time period			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	60C2h	Sub-index	02h
Name	Interpolation time point	Access type	rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Sint8	Data range	-6~-3
Operation mode	—	Default value	-3
Interpolation time point			

Object 60D5h: Probe 1 rising edge count value			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	60D5h	Sub-index	00h
Name	Probe 1 rising edge count value	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	—	Default value	0
Probe 1 rising edge count value			

Object 60D6h: Probe 1 falling edge count value			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	60D6h	Sub-index	00h
Name	Probe 1 falling edge count value	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	—	Default value	0
Probe 1 falling edge count value			

Object 60D7h: Probe 2 rising edge count value			
Objects description		**Objects entry description**	
Attribute	**Value**	**Attribute**	**Value**
Index	60D7h	Sub-index	00h
Name	Probe 2 rising edge count value	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO

Data Type	Uint16	Data range	0~65535
Operation mode	—	Default value	0
Probe 2 rising edge count value			

Object 60D8h: Probe 2 falling edge count value			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	60D8h	Sub-index	00h
Name	Probe 2 falling edge count value	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	—	Default value	0
Probe 2 falling edge count value			

Object 60E0h: Forward maximum torque limit			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	60E0h	Sub-index	00h
Name	Forward maximum torque limit	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	ALL	Default value	8000
Limits the servo's forward maximum torque, unit: 0.1%.			

Object 60E1h: Negative maximum torque limit			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	60E1h	Sub-index	00h
Name	Negative maximum torque limit	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Uint16	Data range	0~65535
Operation mode	ALL	Default value	8000
Limits the servo's negative maximum torque, unit: 0.1%.			

Object 60F4h: User position bias			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value
Index	60F4h	Sub-index	00h
Name	User position bias	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	PP/HM/CSP	Default value	0
Reflects real-time position bias (user position units).			

Object 60FCh: Motor position command feedback			
Objects description		Objects entry description	
Attribute	Value	Attribute	Value

Index	$60FC_h$	Sub-index	00_h
Name	Motor position command feedback	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	PP/HM/CSP	Default value	0

Reflects real-time motor position command.

User position command (object 6062h) × Position Factor (object 6093h) = Motor position command (object 60FChh, encoder units)

Object $60FD_h$: DI input status

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	$60FD_h$	Sub-index	00_h
Name	DI input status	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	ALL	Default value	00000000

Displays DI input status.

Bit	Definition
0	Negative limit switch (drive's DI pin 43, defaults to 0 when no input level is applied)
1	Positive limit switch (drive's DI pin 42, defaults to 0 when no input level is applied)
2	Home switch (drive's DI pin 40, defaults to 0 when no input level is applied)
3~9	Reserved (defaults to low level, value 0)
10	Z pulse (no configuration required)
11	Probe 1 (default value: 1)
12	Probe 2 (default value: 1)
13	Reserved (defaults to low level, value 0)
14	Reserved (defaults to low level, value 0)
15	Reserved (defaults to low level, value 0)
16	DI0 (default value: 1)
17	DI1 (default value: 1)
18	DI2 (default value: 1)
19	DI3 (default value: 1)
20	DI4 (default value: 1)
21	DI5 (default value: 1)
22	DI6 (default value: 1)
23	Reserved (defaults to low level, value 0)
24	Reserved (defaults to low level, value 0)
25~30	Reserved (defaults to low level, value 0)

Object $60FE_h$: Force DO output

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	$60FE_h$	Sub-index:	01_h
Name	Force DO output status	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295
Operation mode	ALL	Default value	0

Attribute	**Value**	**Attribute**	**Value**
Index	$60FE_h$	Sub-index:	02_h
Name	Bit mask	Access type	Rw
Data structure	/	PDO Mapping type	RxPDO
Data Type	Uint32	Data range	0-4294967295

Operation mode	ALL	Default value	0

This function forces DO output (EtherCAT servos currently provide only 4 DO outputs).

Bit	Definition
0	0: DO0 not output; 1: DO0 output
1	0: DO1 not output; 1: DO1 output
2	0: DO2 not output; 1: DO2 output
3	0: DO3 not output; 1: DO3 output
4~15	Reserved
16~24	Reserved

Object 60FF$_h$: Target speed

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	60FF$_h$	Sub-index	00$_h$
Name	Target speed	Access type	rw
Data structure	Variable	PDO Mapping type	RxPDO
Data Type	Sint32	Data range	-2147483648~2147483647
Operation mode	PV/CSV	Default value	0

Sets the user speed command in Profile Velocity/Cyclic Synchronous Velocity Mode.

Object 6502$_h$: Supported servo operation modes

Objects description		Objects entry description	
Attribute	**Value**	**Attribute**	**Value**
Index	6502$_h$	Sub-index	00$_h$
Name	Supported servo operation modes	Access type	ro
Data structure	Variable	PDO Mapping type	TxPDO
Data Type	Uint32	Data range	0~4294967295
Operation mode	ALL	Default value	941

Displays the servo operation modes supported by the drive.

bit	Definition	Remarks
0	Profile position mode (PP)	
1	Velocity mode	Not supported
2	Profile velocity mode (PV)	
3	Profile torque mode (PT)	
4	Reserved	
5	Homing mode (HM)	
6	Interpolated position mode (IP)	Not supported
7	Cyclic synchronous position mode (CSP)	
8	Cyclic synchronous velocity mode (CSV)	
9	Cyclic synchronous torque mode (CST)	
10~31	Reserved	

Chapter 12 Application examples

12.1 Connection example with HCFA Q series

12.1.1 Project creation

1. Open the HCP Work3 software and click [New Project].

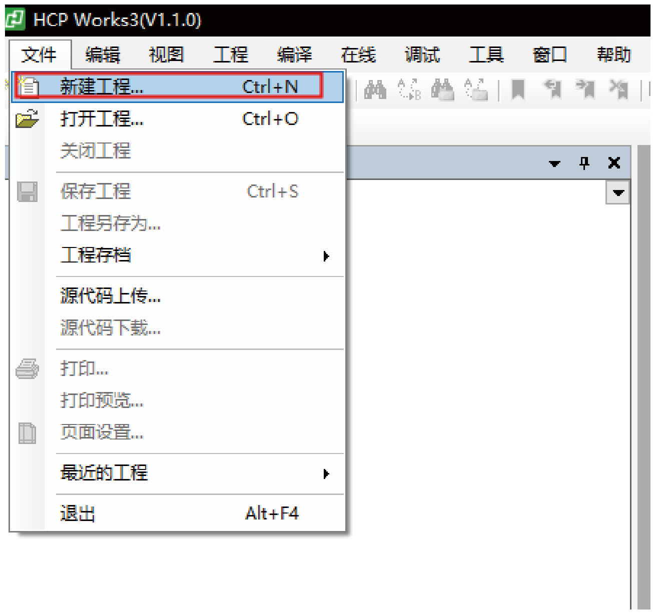


Figure 12-1 New project

2. This example uses the Q5P PLC, so select HCQ5P-1500. The default language is Structured Text (ST). After editing the name and selecting the storage location, click [OK].

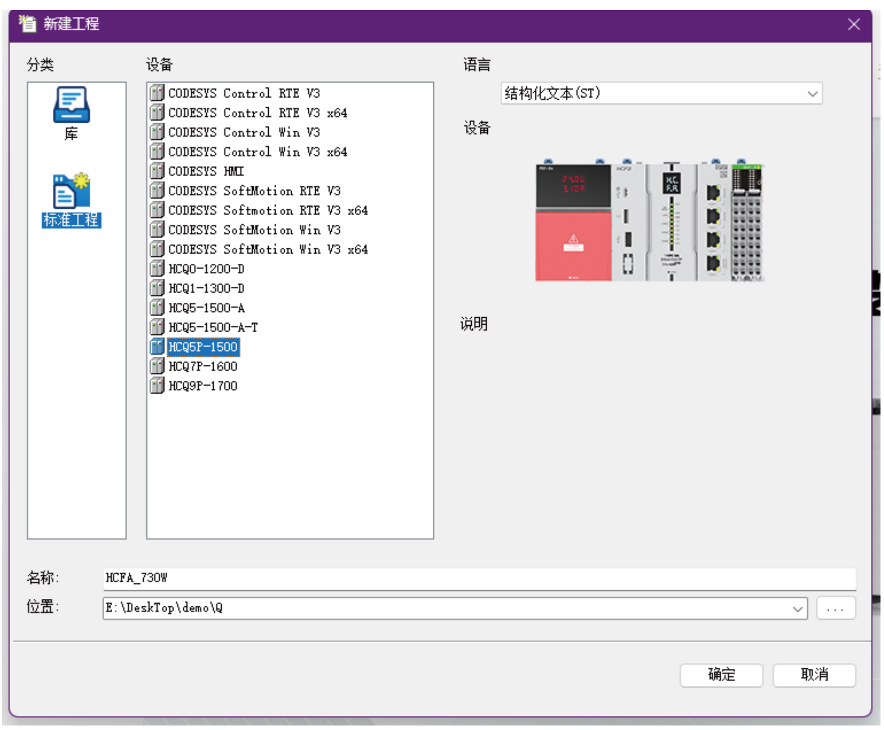


Figure 12-2 Project details

12.1.2 Host communication settings

1. The default IP address of HCQ5P-1500 PORT1 is 192.168.188.100, and the default IP address of PORT2 is 192.168.88.100. This experiment uses PORT2. Open Ethernet settings, click [Properties] → [Internet Protocol Version 4 (TCP/IPv4)] → modify the host PC IP address so that it is on the same subnet as the Q5P-1500 IP address (the IP address set here must not be exactly the same as the IP address of Q5P-1500), and finally click [OK].

Figure 12-3 Project details

2. Double-click [Device]. After the page pops up, click [Scan Network]. After the controller network selection pops up, select the PLC to be used and click [OK].

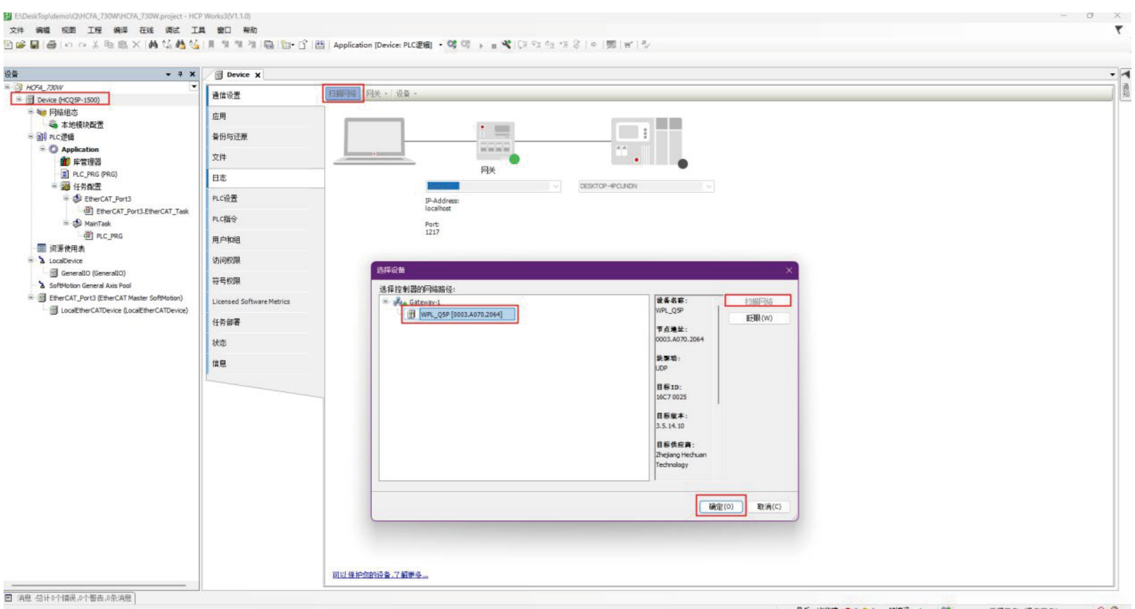


Figure 12-4 Network connection

12.1.3 Project editing

1. Check whether an XML file matching the drive version exists in the device repository. If not, it needs to be added manually.

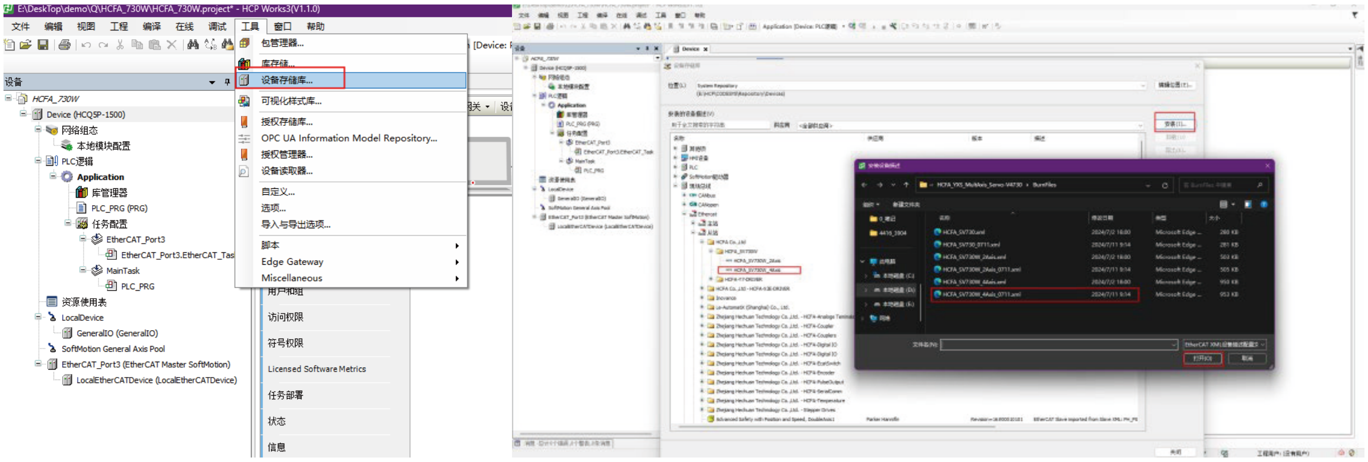


Figure 12-5 Adding XML

2. Return to the software, right-click [EtherCAT_Master_Softmotion] and select [Add Device].

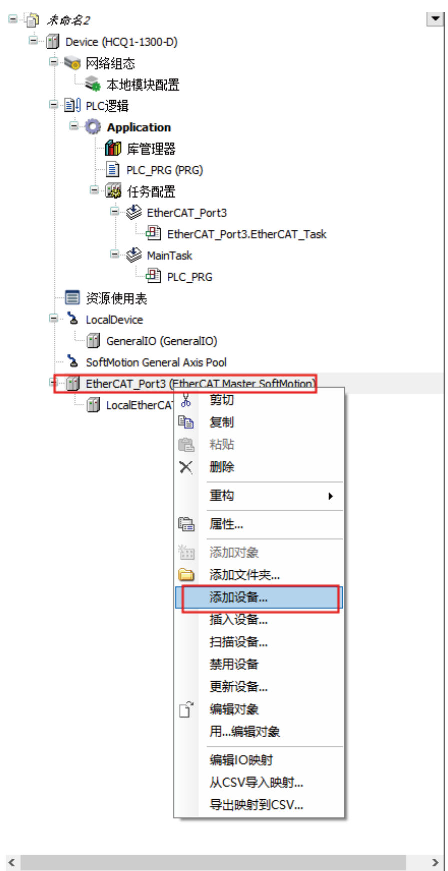


Figure 12-6 Add device

3. Select HCFA_SV730W. In the pop-up page, select [HCFA_SV730W_4Axis] and click [Add Device].

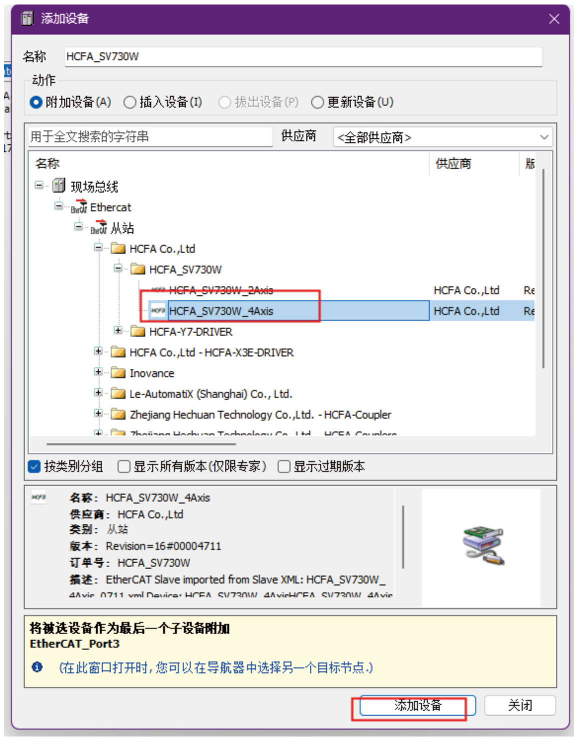


Figure 12-7 Select [HCFA_SV730W_4Axis]

4. To observe parameters in CoE, double-click [HCFA_SV730W_4Axis] and check [Expert Settings].

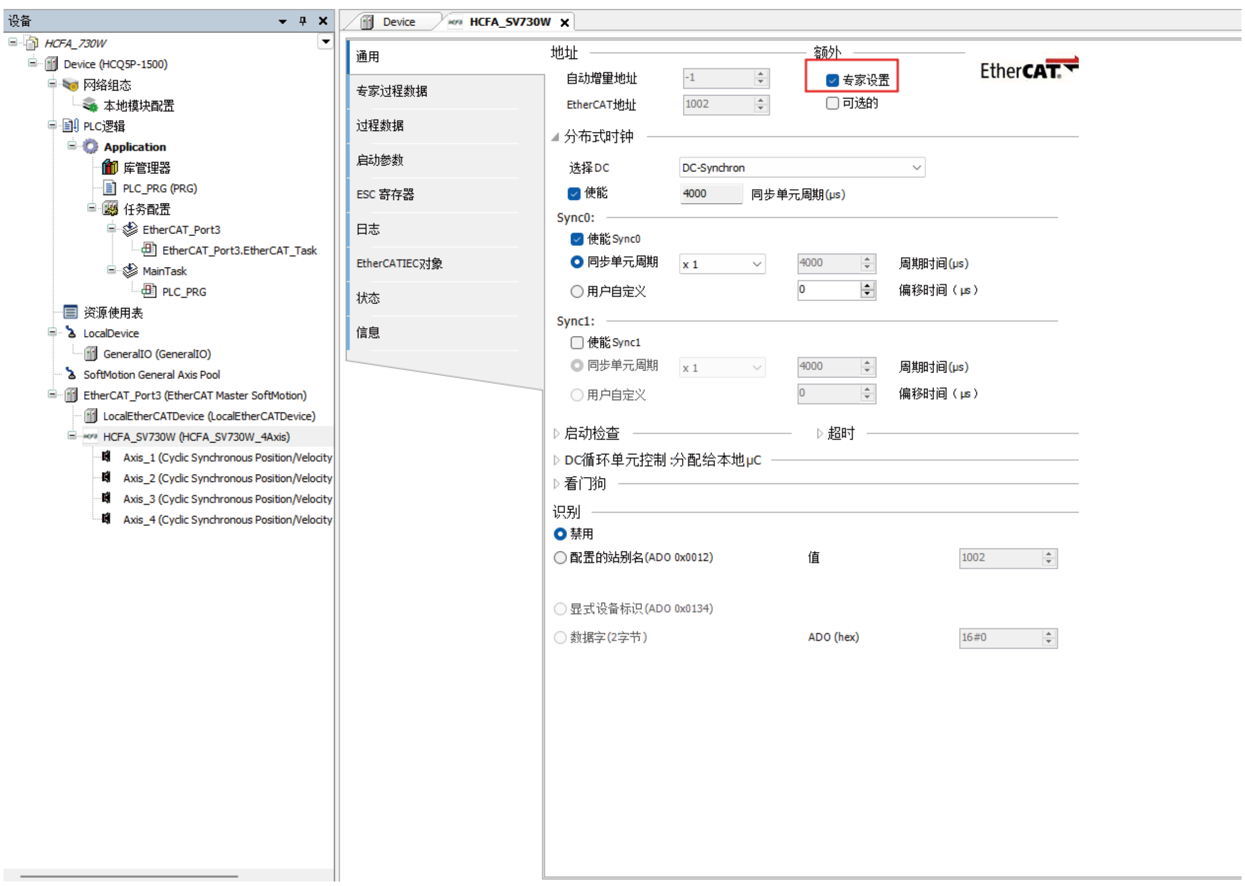


Figure 12-8 Observing parameters in CoE

5. Right-click [HCFA_SV730W_4Axis] and select [Add SoftMotion CiA402 Axis] (add 4 times).

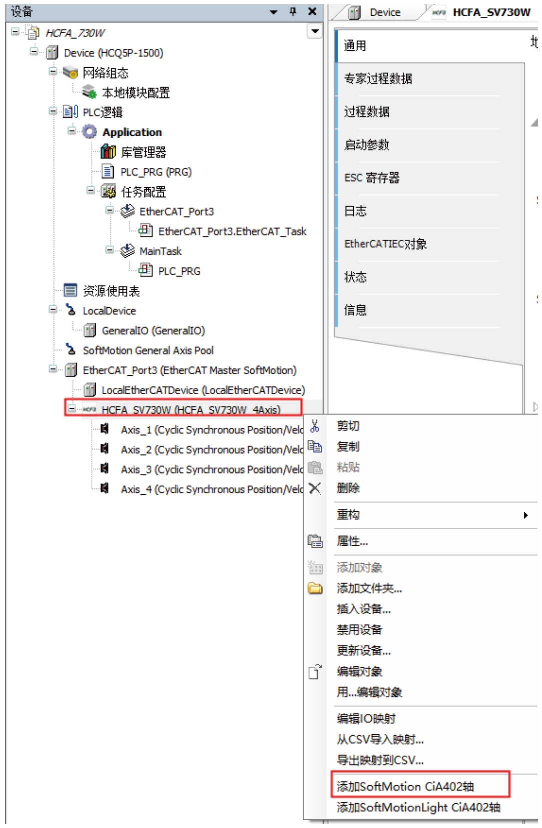


Figure 12-9 Adding SoftMotion CiA402 axis

6. To make axes easier to understand and correspond, they can be renamed.

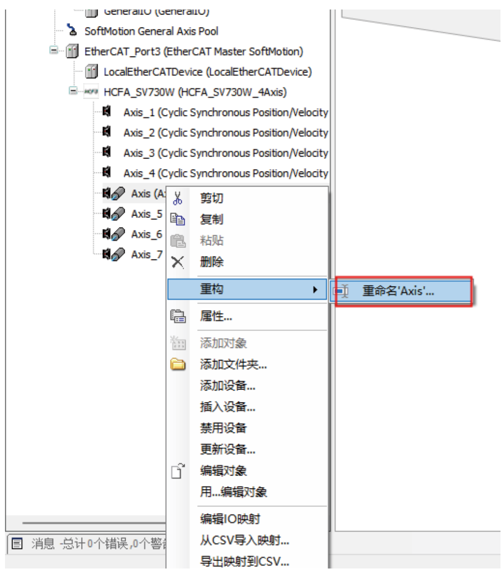


Figure 12-10 Rename

7. Double-click to open [axis1]. In increments, enter [8388608], which means one motor revolution corresponds to 8,388,608 pulses. In units in application, enter [60], which means one motor revolution corresponds to a load movement of 60 units. (Same setting applies to other axes.)

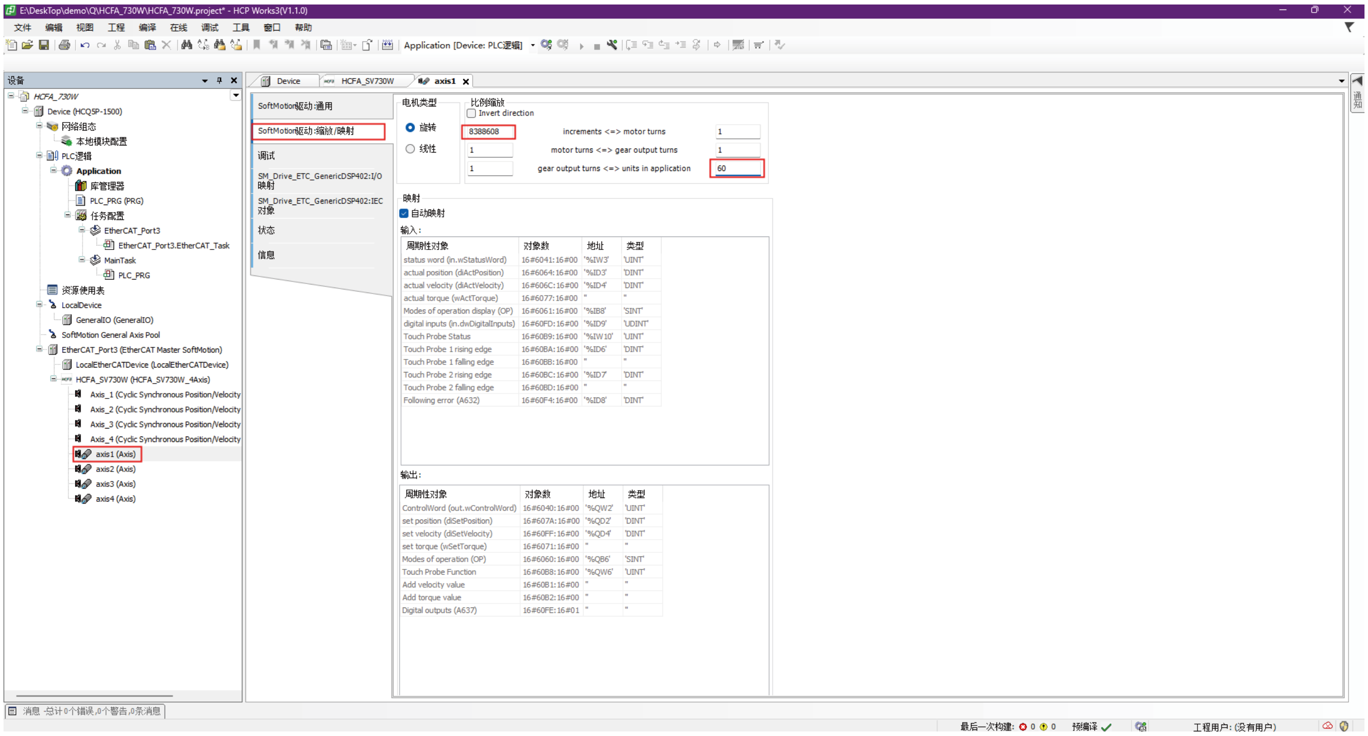


Figure 12-11 Scaling configuration

8. Double-click [EtherCAT_Master_SoftMotion]. In the pop-up page, click [Browse]. In the next pop-up page, select the MAC address named [port3] and click [OK].

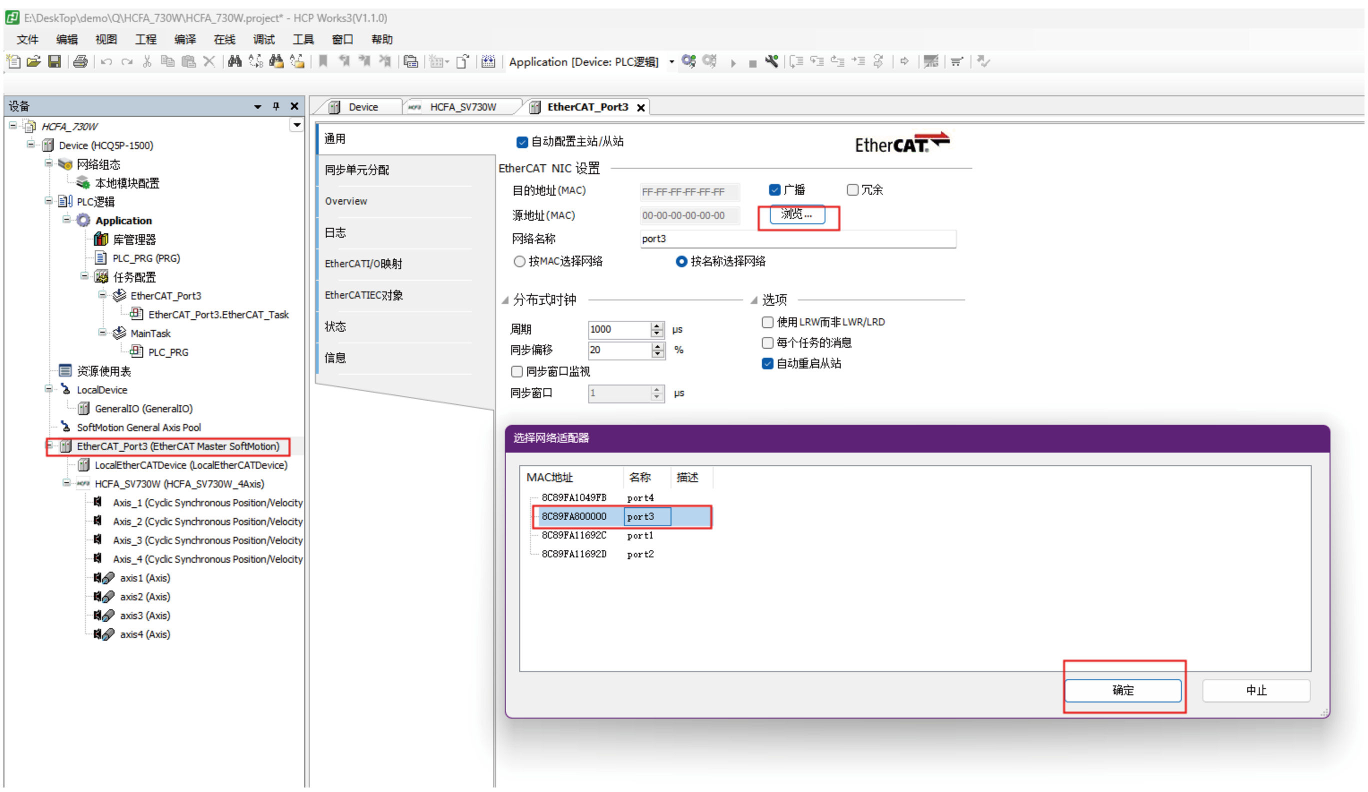


Figure 12-12 Network configuration selection

9. Go to the menu bar, right-click MainTask, and select [Delete].

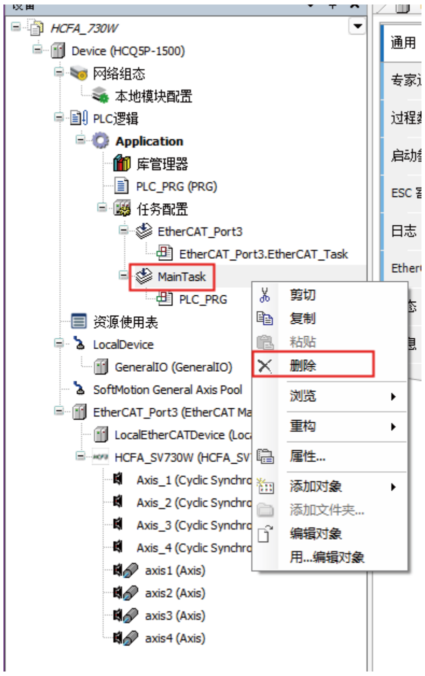


Figure 12-13 Deleting Main Task

10. Go to the menu bar, under task configuration, right-click EtherCAT(POU) under EtherCAT_Port3, and select [Delete].

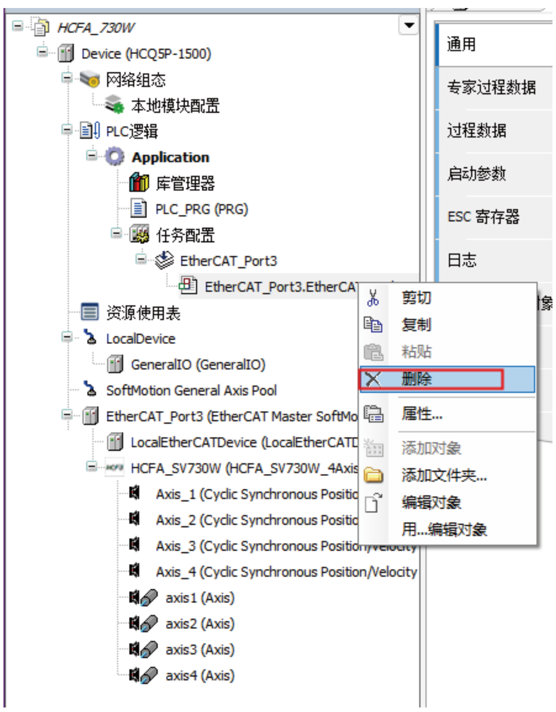


Figure 12-14 Deleting EtherCAT POU

11. Left-click and drag PLC_PRG (PRG) under Application to EtherCAT_Port3

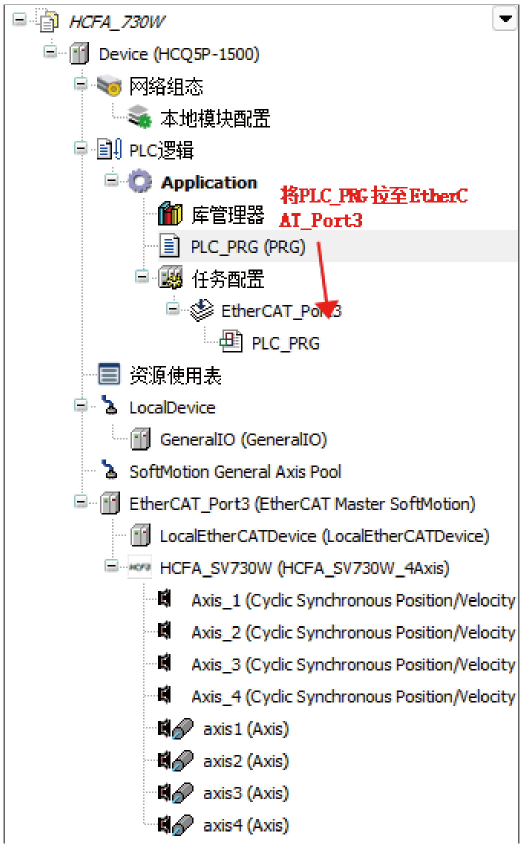
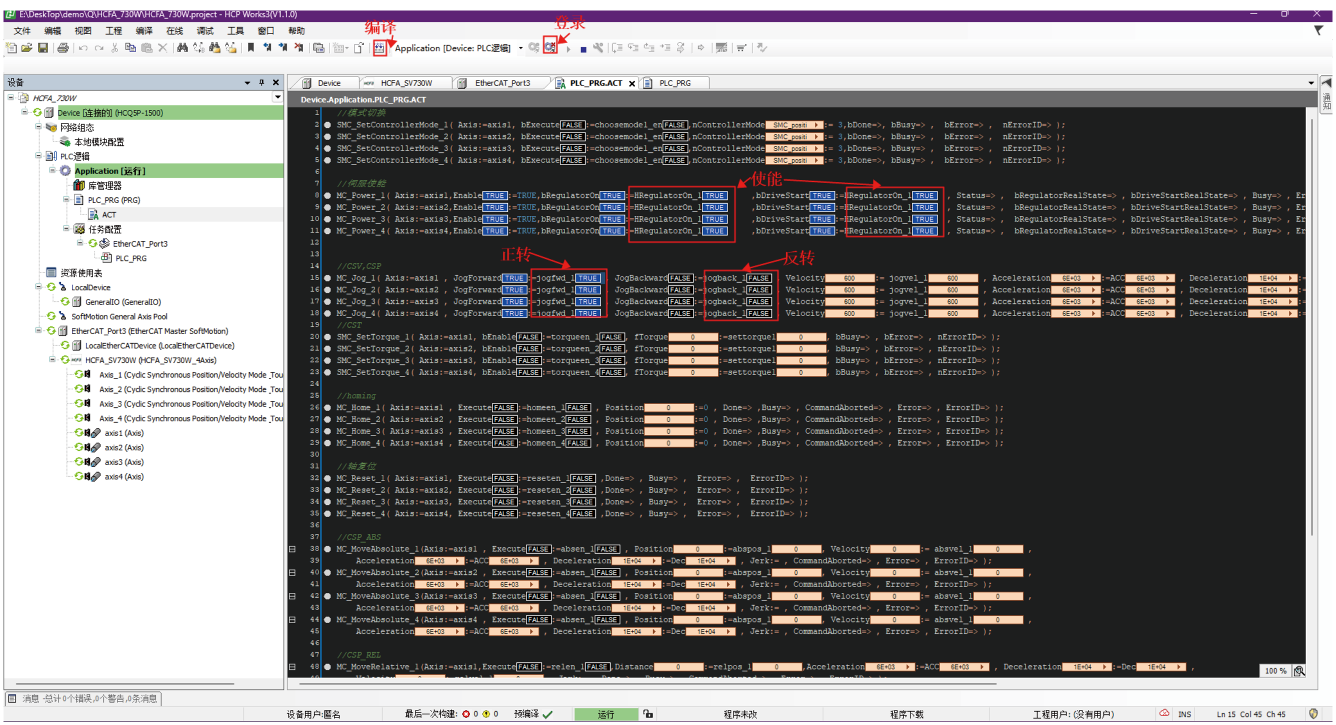


Figure 12-15 Moving PLC_PRG (PRG)

12.1.4 Trial operation

1. After writing the relevant code, compile, log in, and click the relevant enable module.



2. After completing the corresponding operations, the corresponding motor movements can be observed.

12.2 Connection example with Omron PLC NJ-501-1300

12.2.1 Connecting to Omron PLC

1. PLC connection includes USB connection and network connection. When using USB connection, select "USB Direct Connection" → Connect.

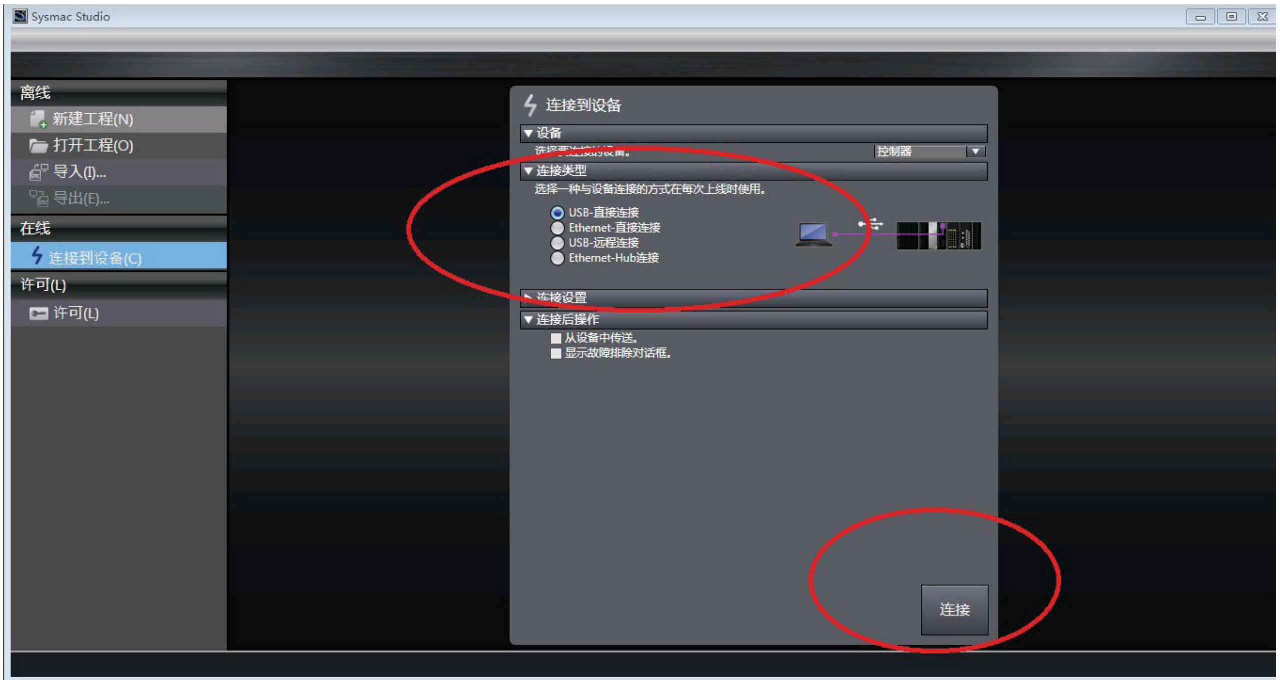


Figure 12-16 USB connection of PLC

2. When the PLC is connected via network (EtherCAT port): Set the computer IP address to the same subnet as the PLC. Go to Computer → Local Connection → Properties → Internet Protocol Version 4 (TCP/IPv4) Properties → Use the following IP address, as shown in the figure below: The default is 192.168.250.X (X is a value from 2 to 255; the factory default address of the Omron CPU is 192.168.250.1).

3. Open the Sysmac Studio software, select "Connect to Device" → select "Ethernet-Hub Connection" as the connection type → enter the IP address in "Connection Settings": 192.168.250.1 → finally click "Connect" to enter the PLC programming page.

Figure 12-17 Connecting to PLC

12.2.2 Adding HCFA servo drive

1. Add the HCFA 730W EtherCAT servo drive XML file: Expand "Configuration and Setup" → double-click "EtherCAT" → right-click and select "Master Device" → display ESI library and open "This Folder" → copy the HCFA 730W EtherCAT XML file into this folder. Restart Sysmac Studio to make the 730W EtherCAT XML file effective.

Note: The XML file of the HCFA 730W is continuously maintained and updated without prior notice to users.

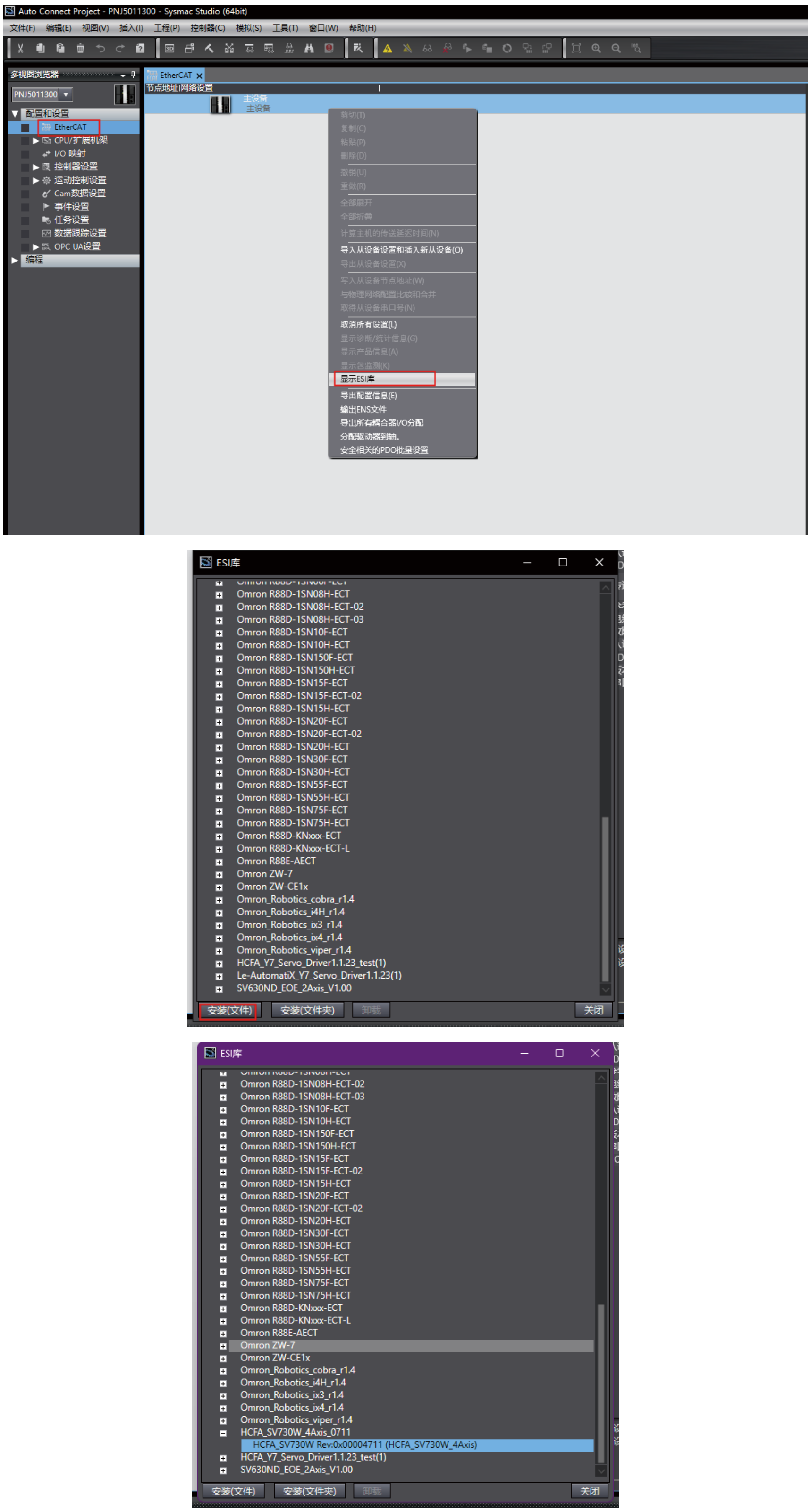
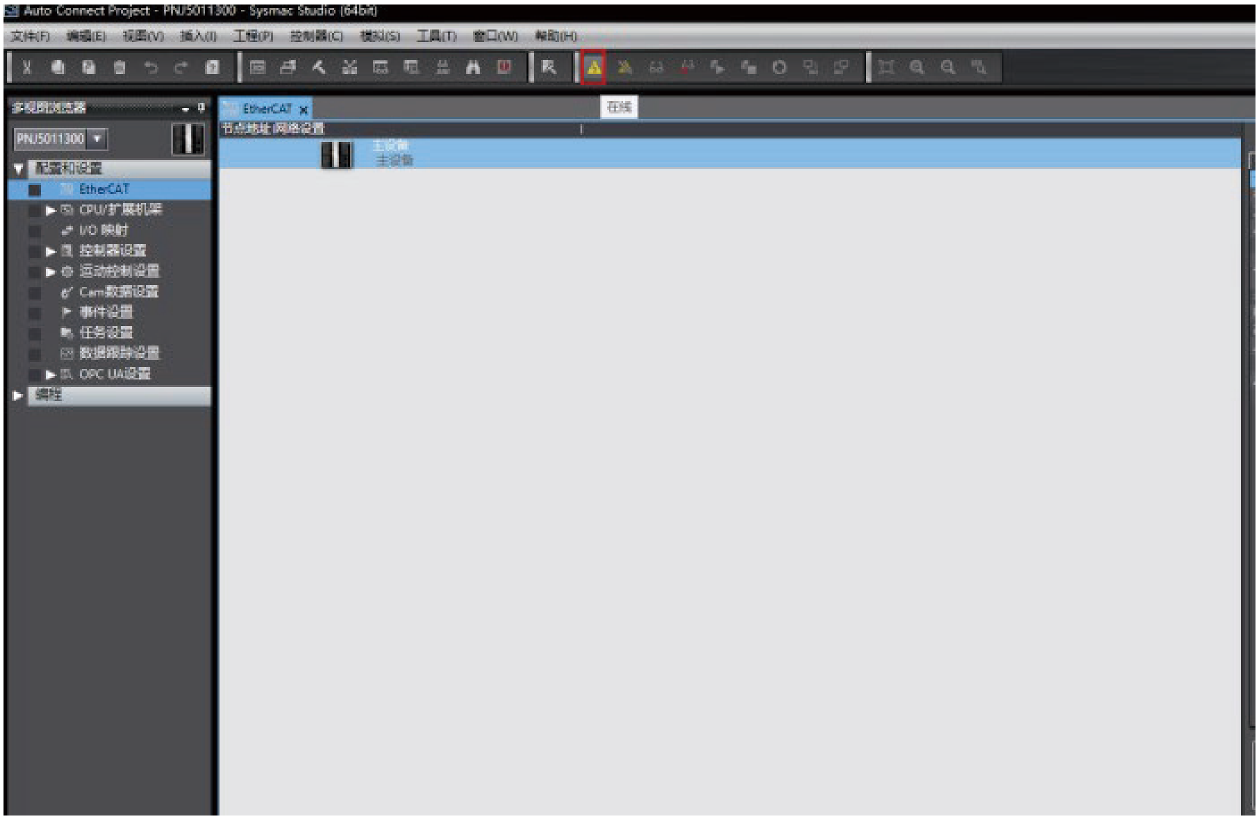
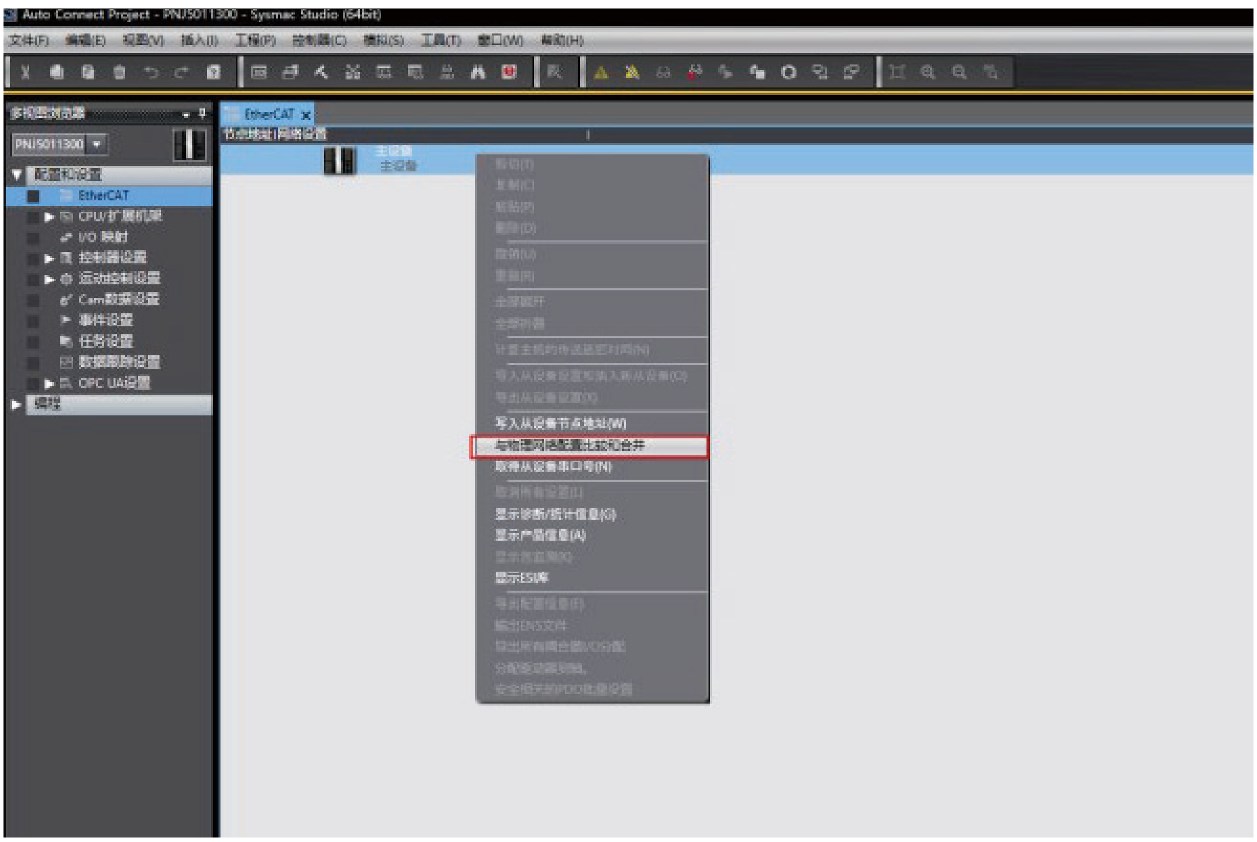


Figure 12-18 Installing the 730W XML file

12.2.3 Setting EtherCAT related parameters

1. Add the 730W slave station (the PLC must be online): After reconnecting the PLC, expand "Configuration and Setup" → double-click "EtherCAT" → right-click and select "Master Device" → Compare and merge with physical network configuration → an error message "Node address out of range" appears → click "Show dialog for writing slave node address" → the "Writing slave node address" dialog pops up → write node address "1" → click "Write" → then disconnect the power of the 730W servo → power on the 730W servo again. The node address is successfully written.





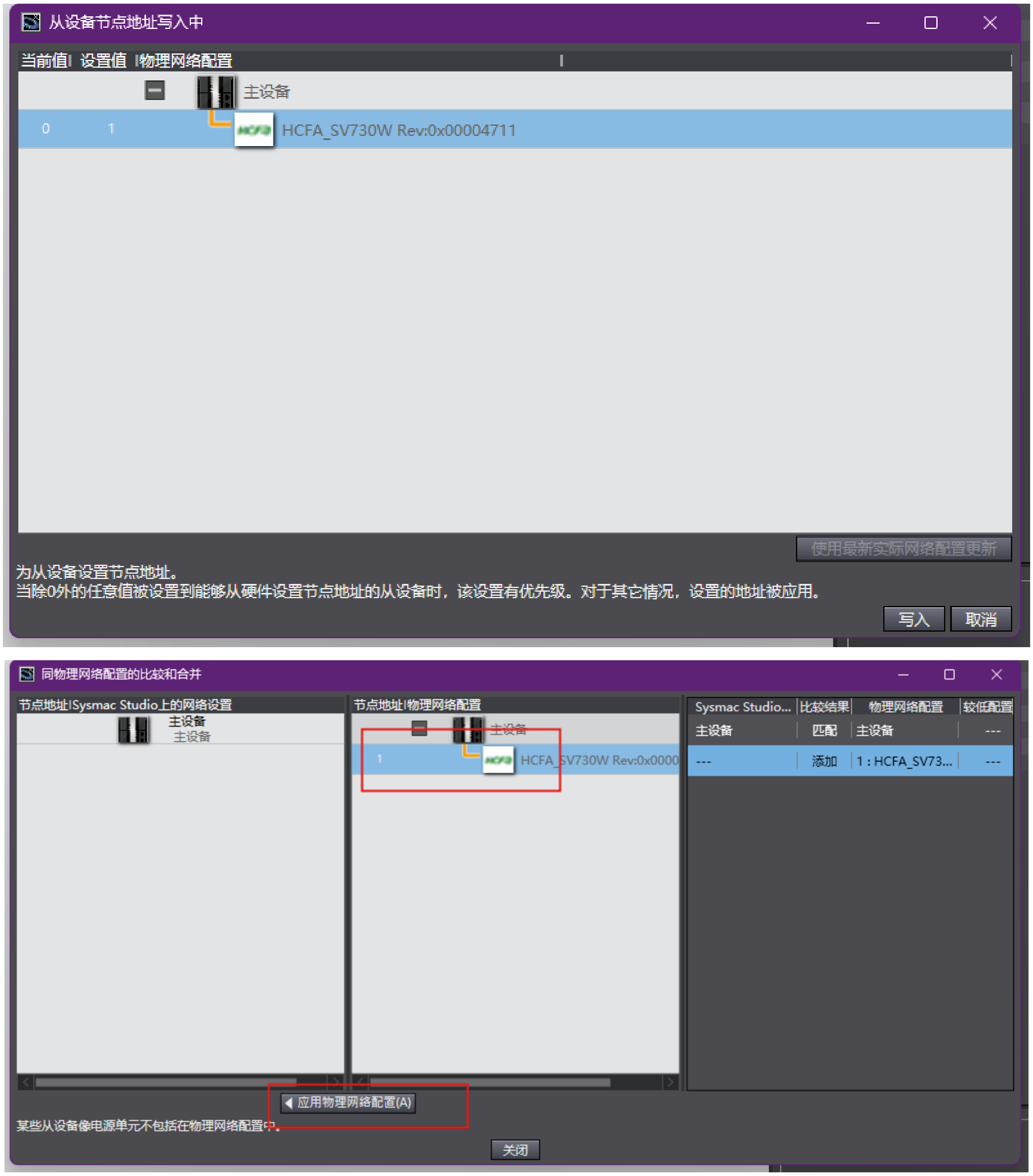


Figure 12-19 Adding 730W

3. Click Node 4-Servo Driver and drag the corresponding options under the input keyword into the module (4 groups).

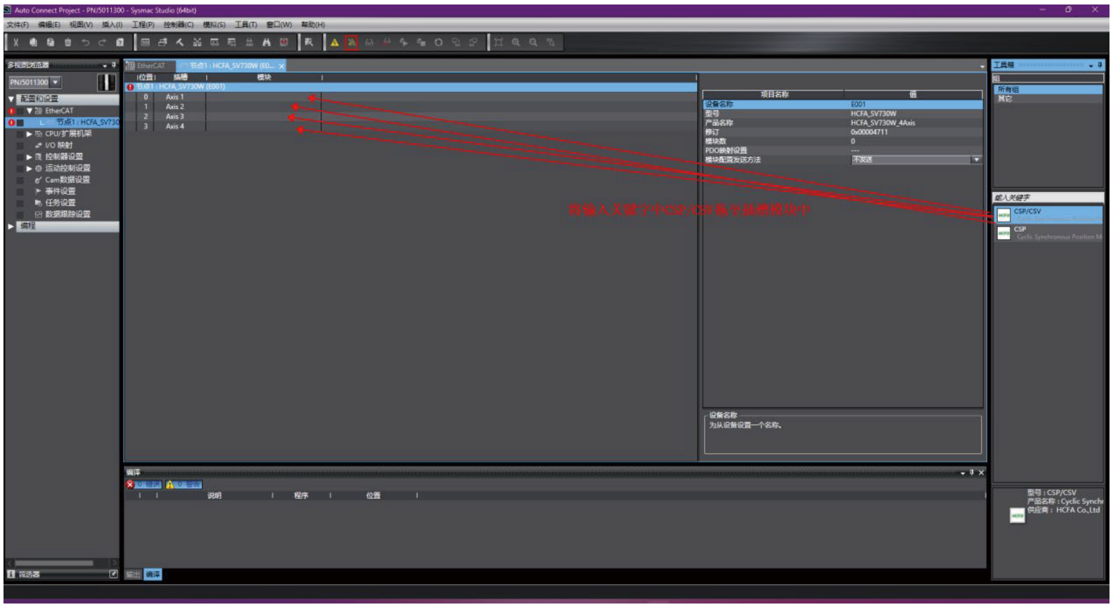


Figure 12-20 Configuring node

4. Adding a motion axis (PLC needs to be offline): Main menu "Controller" → Offline → Expand "Motion Control Settings" → Axis Settings → Add "Motion Control Axis". (4 groups)

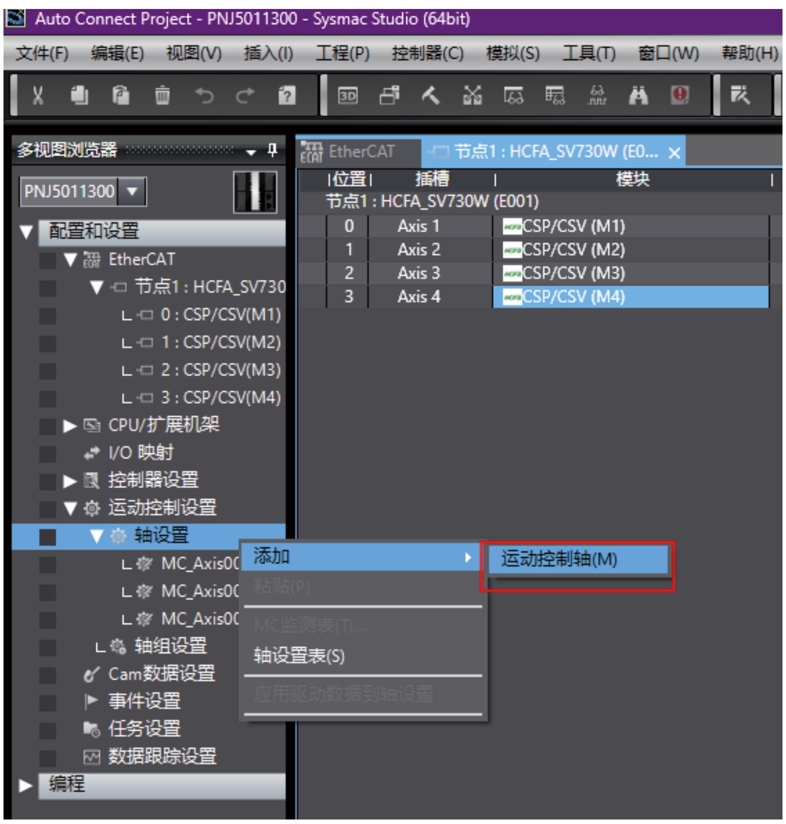


Figure 12-21 Adding motion control axis

5. Setting motion control axis parameters

(1) Adding a servo axis: On the axis basic settings page, set the axis type to Servo Axis. Configure "Output Device 1" as Slot 0 (M1) (corresponding to the first axis). Configure the other three axes in the same way. The configuration is shown in the figure below:

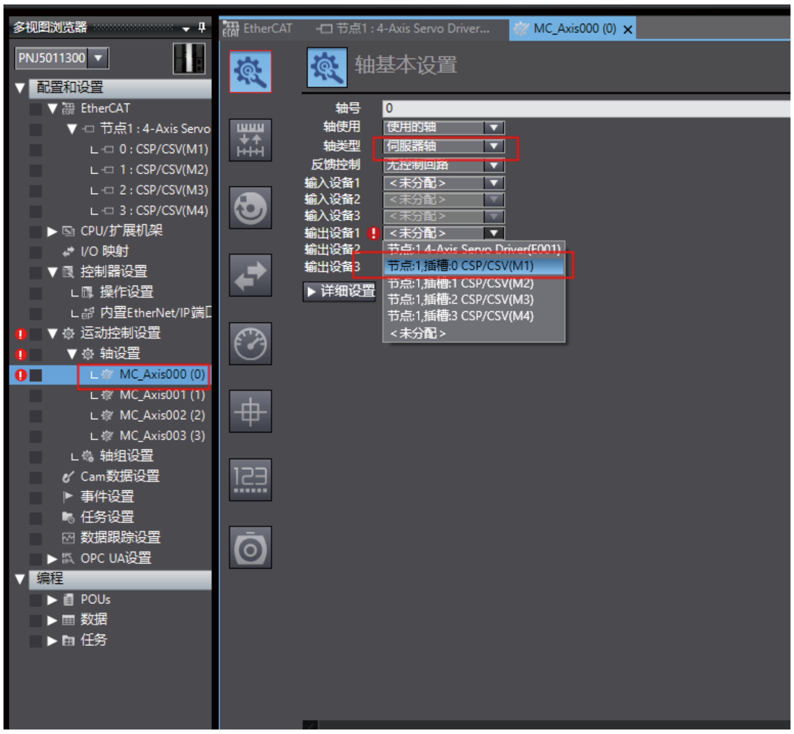


Figure 12-22 Adding servo axis

(2) Mapping motion control axis PDO parameters:

The 730W servo drive must have PDO parameters configured manually. Double-click MC_Axis000 (0) to enter the axis basic settings page → Click Detailed Settings → Configure the relevant parameters for Output (Controller to Device), Input (Controller to Device), and Digital Input respectively. An example is shown below (the other three axes are configured in the same way).

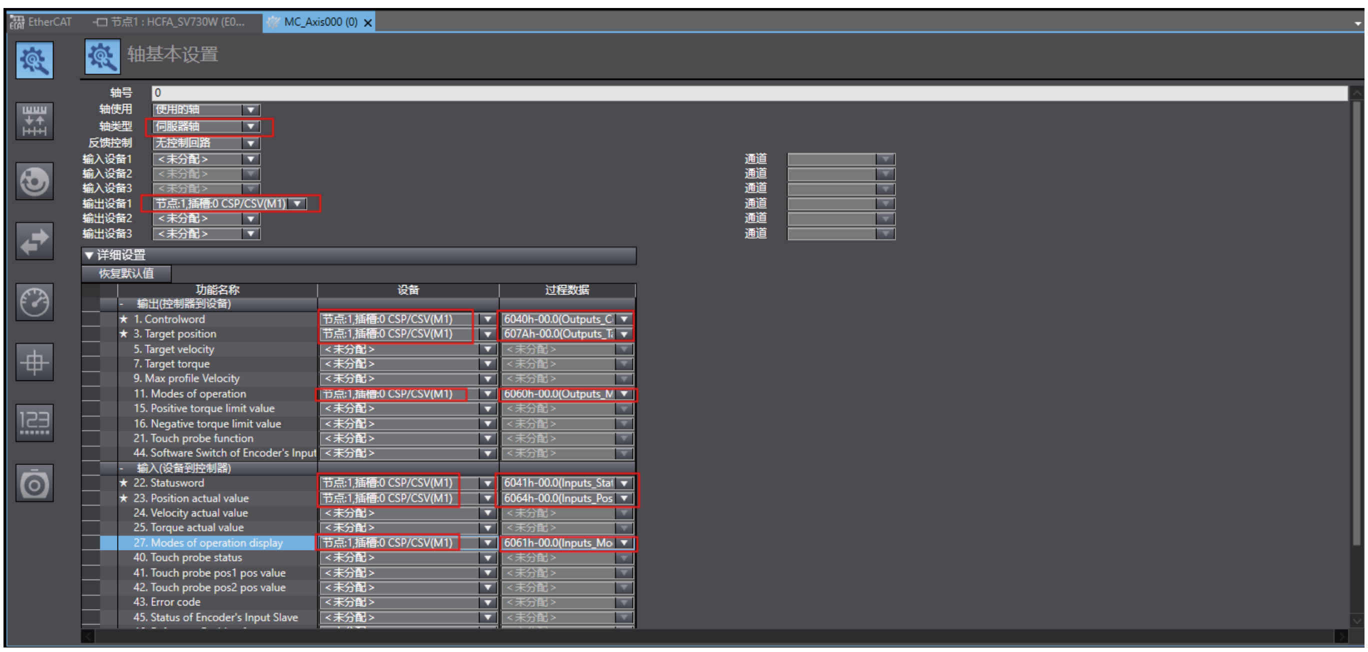


Figure 12-23 Mapping motion axis PDO parameters

Note: Due to limitations in the Omron background configuration, all 730W servo axis configurations need to be completed manually.

(3) Unit conversion settings:

On the MC_Axis000 (0) page → go to the unit conversion settings page → set the appropriate parameters. An example is shown below:

Work travel per motor revolution: Currently, HCFA commonly uses a 23-bit resolution encoder, so it should be set to 8388608.

Command per motor revolution: Can be set according to requirements. Command per motor revolution = 8388608 means that 60 command units correspond to one motor revolution.

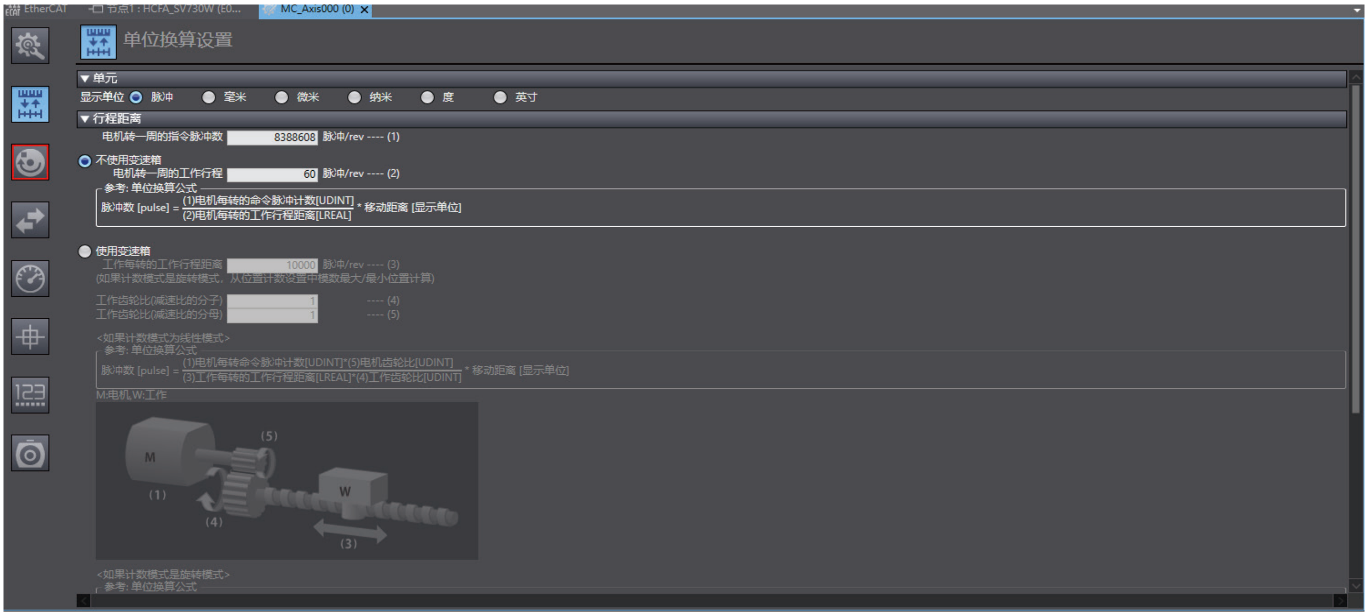


Figure 12-24 Unit conversion

(4) Set appropriate speed, acceleration, and deceleration.

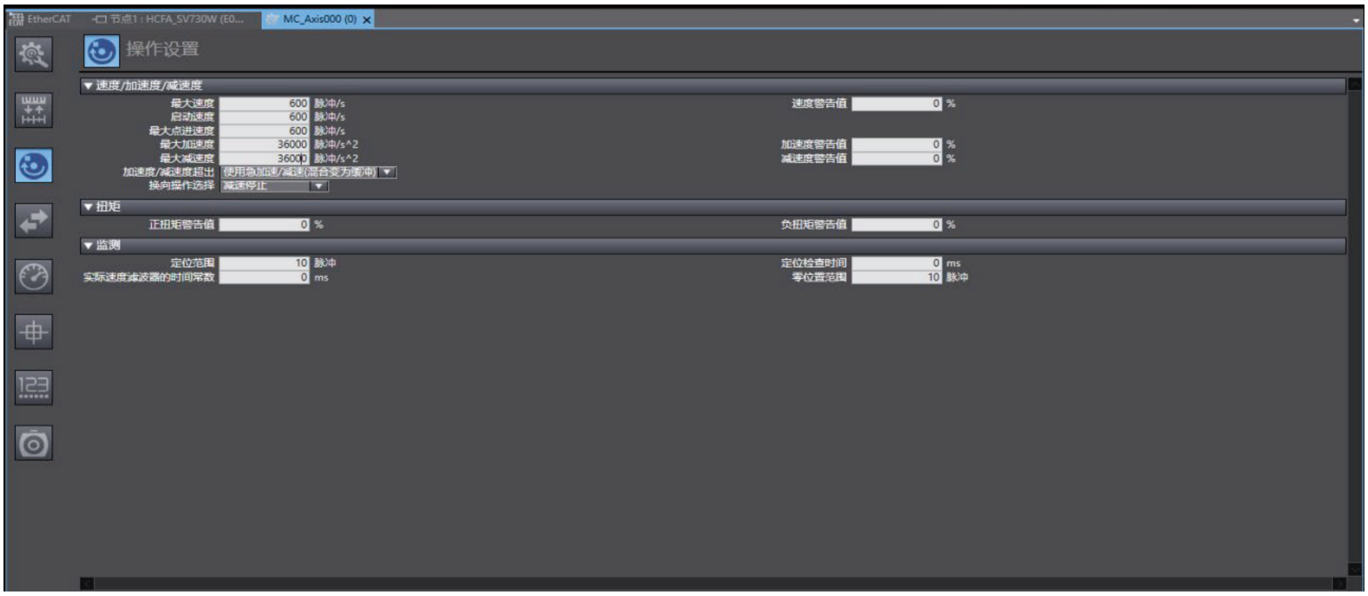


Figure 12-25 Setting speed

(5) Select the required homing mode, homing speed, and other parameters.

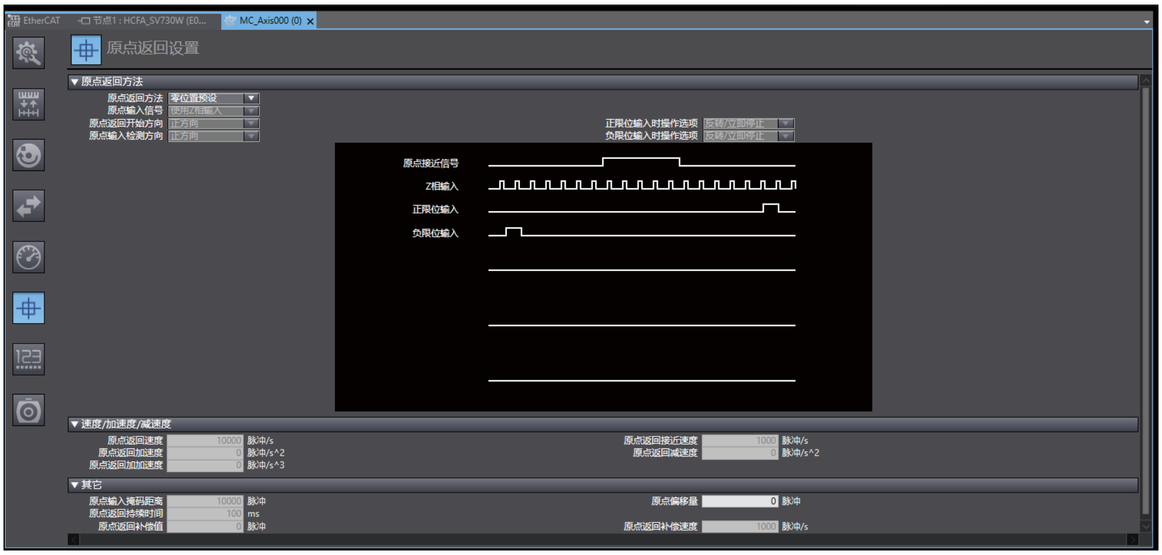


Figure 12-26 Selecting homing mode

12.2.4 Trial operation

1. Write the relevant program. In this example, a JOG test program is used.

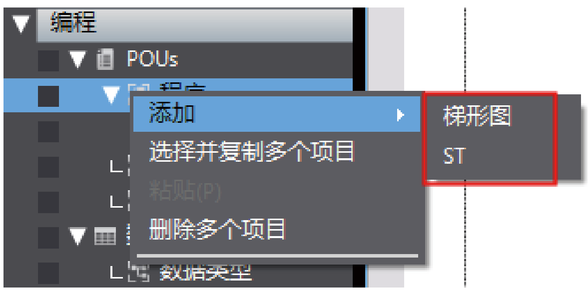


Figure 12-27 Adding program

(1) Write the JOG test program.

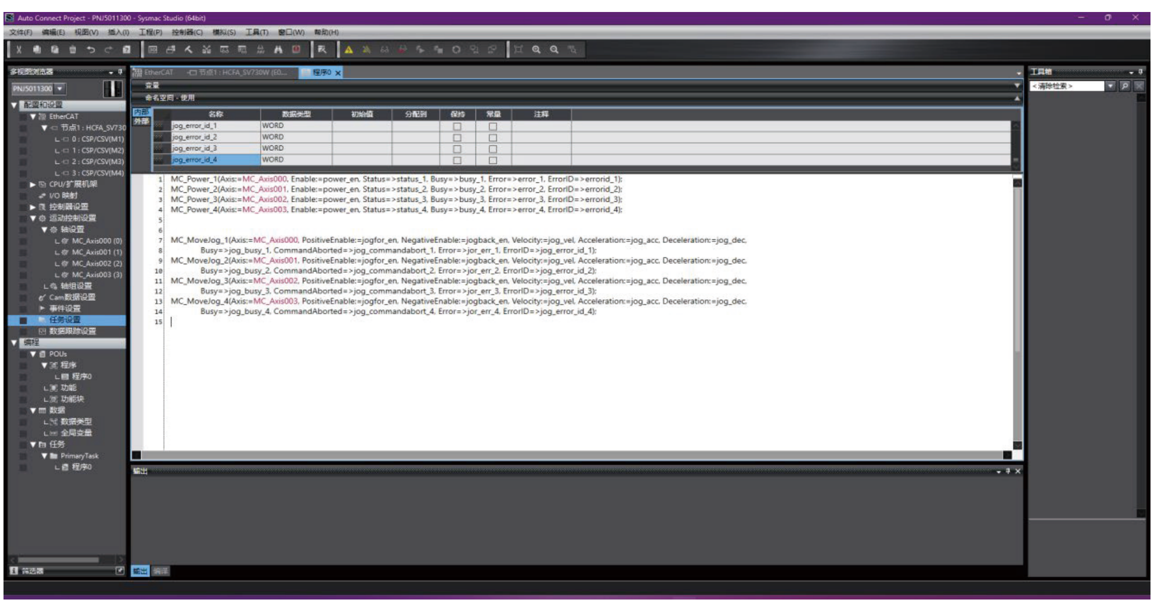


Figure 12-28 Writing the JOG test program

(2) Add the corresponding program name in the task settings.

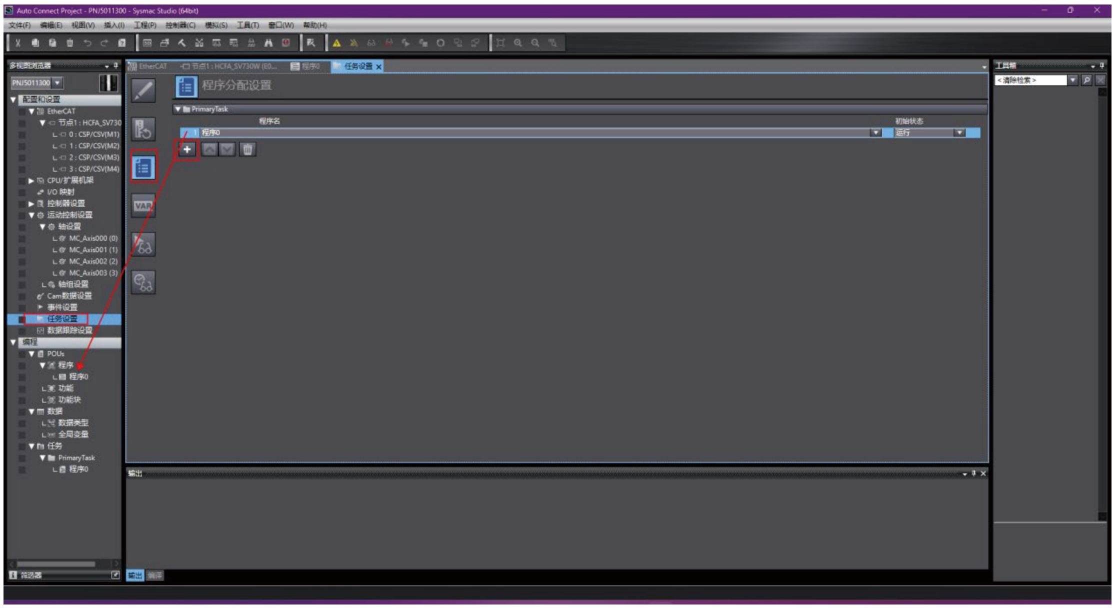
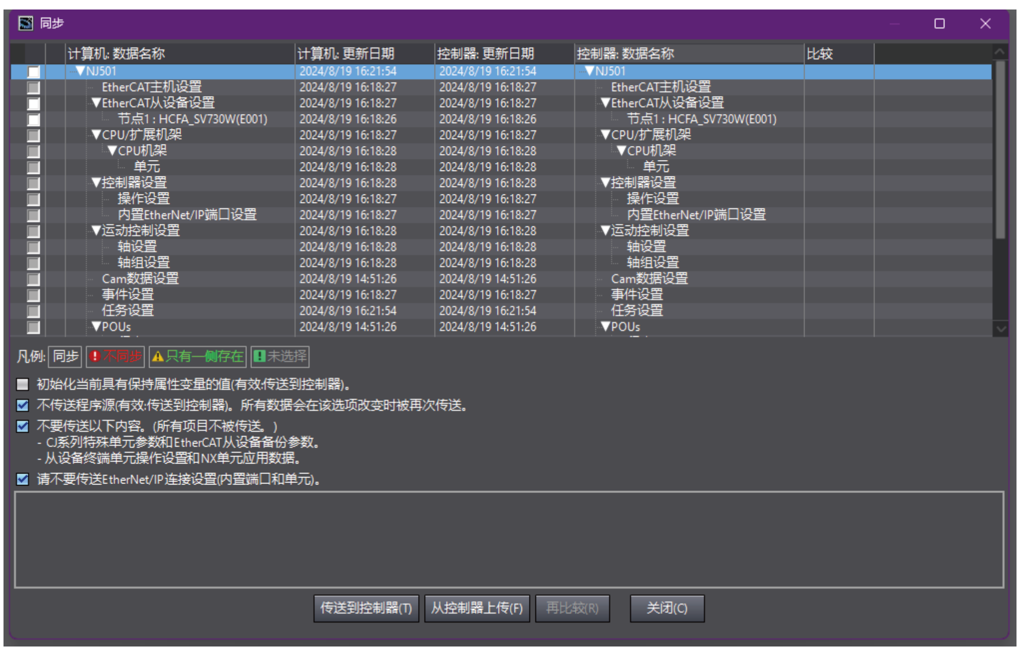


Figure 12-29 Adding program name

2. Compile, go online, and synchronize to the PLC.

Figure 12-30 Online, compile, synchronize

Click Transfer to Controller.



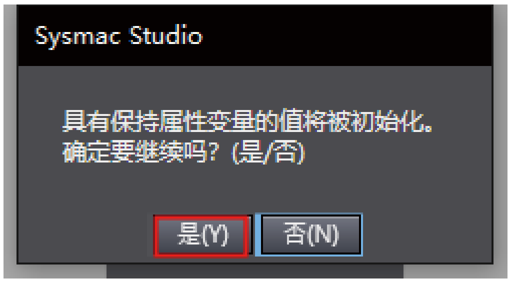


Figure 12-31 Transfer to controller

3. After enabling, JOG can be used to see the motor complete the corresponding rotation.

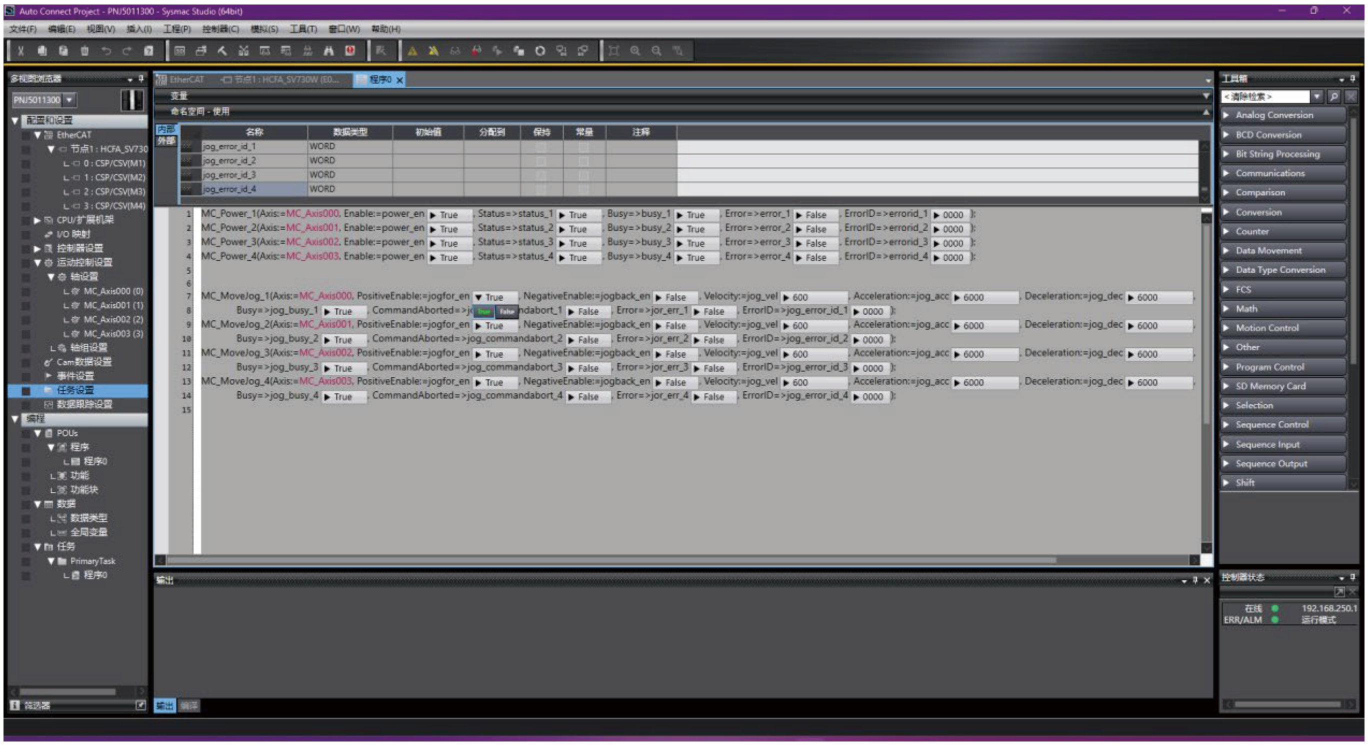


Figure 12-32 Operation

12.3 Connection example with Beckhoff PLC CX5130

12.3.1 Creating connection

1. Place the 730W XML file in the TwinCAT3 root directory: C:\TwinCAT\3.1\Config\Io\EtherCAT. Right-click the TwinCAT3 icon in the bottom right corner, select System → Config to switch the TwinCAT3 state to ensure that the description file is updated successfully.

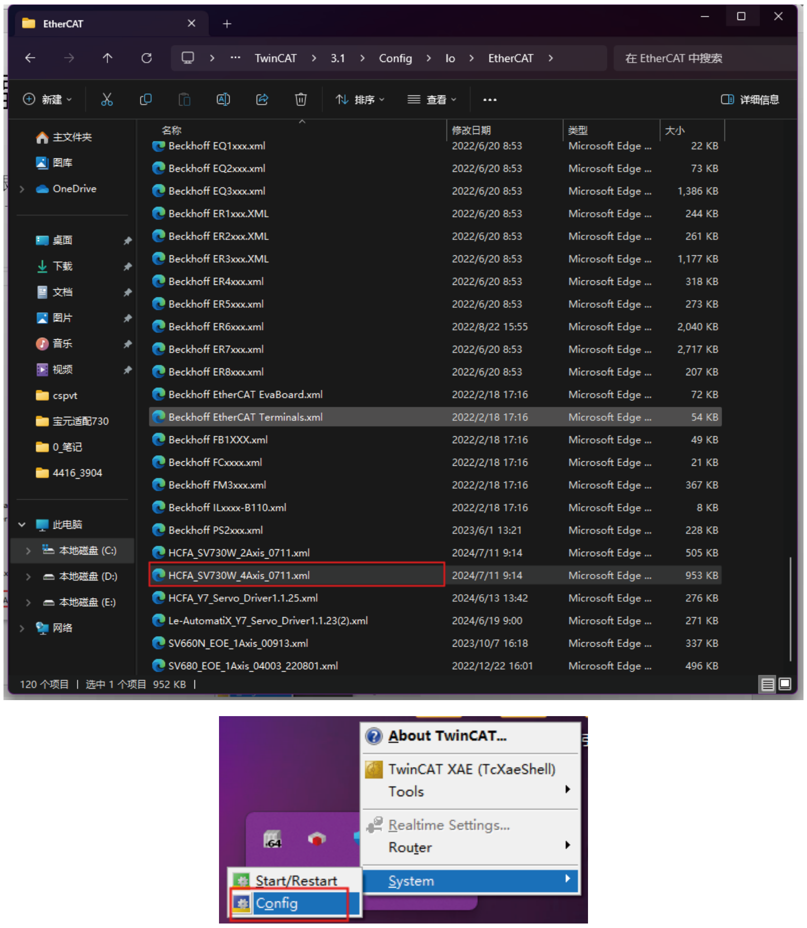


Figure 12-33 Storing the description file

2. Create a new TwinCAT3 solution

After completing the connection between the PC (or Beckhoff controller/industrial PC) and the 730W servo drive, click the TwinCAT3 icon and select TwinCAT XAE. After opening the TwinCAT3 software, select the menu File → New → Project. In the New Project dialog box, select TwinCAT Project under Templates on the left side, enter the solution name and storage path, then click OK to complete the creation.

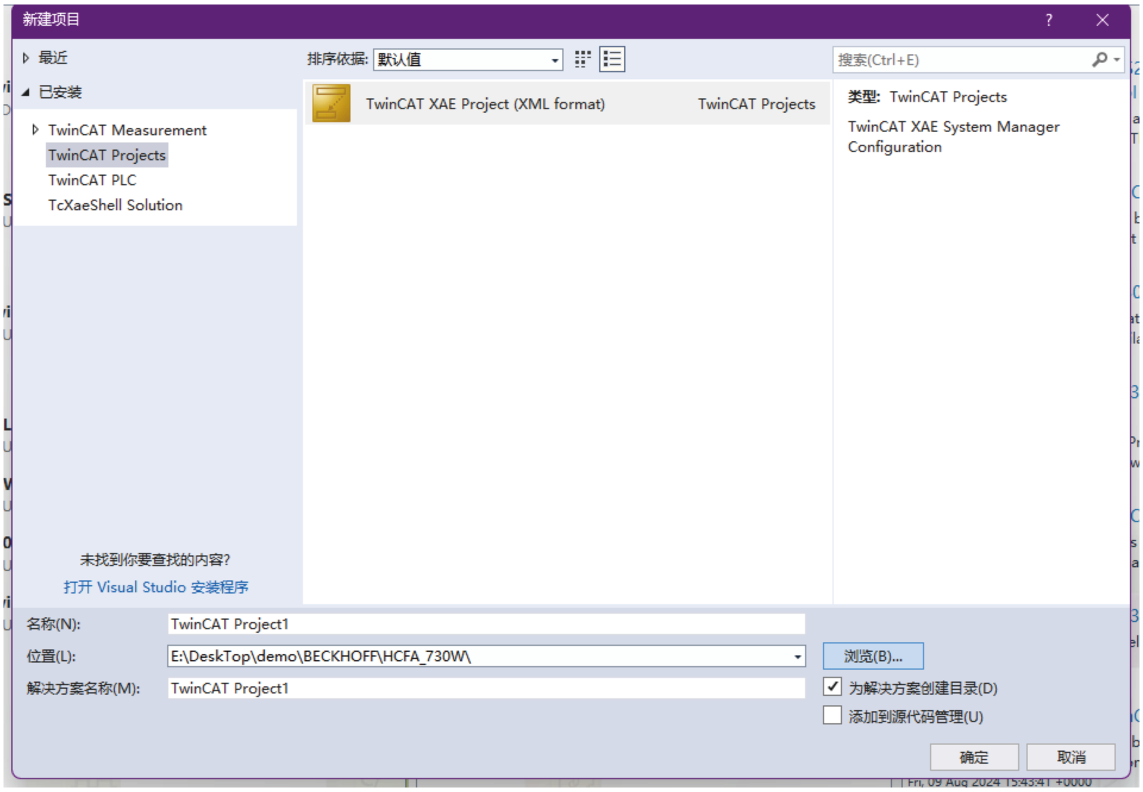
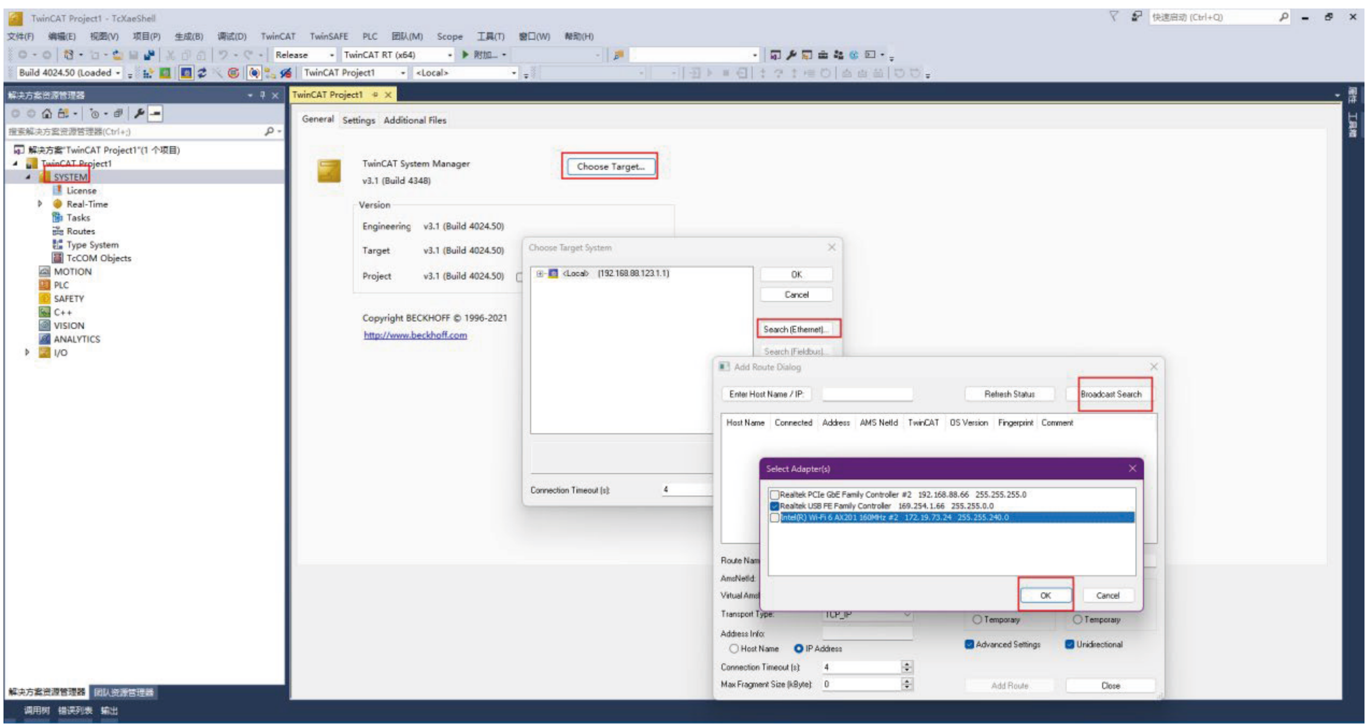


Figure 12-34 Creating a new solution

3. Connect the Beckhoff PLC CX5130.



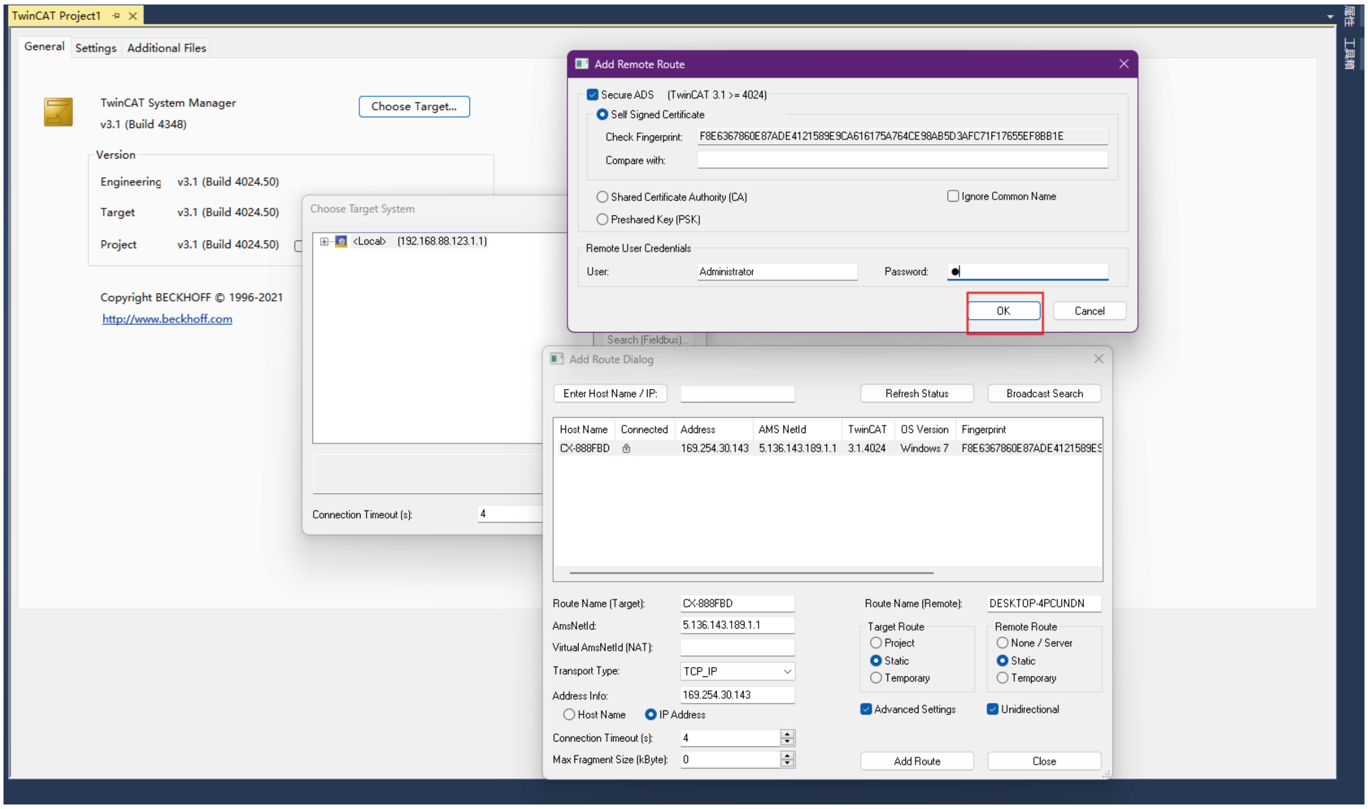


Figure 12-35 Connecting to Beckhoff PLC

4. Scanning the drive

Switch TwinCAT3 to configuration mode, then scan the I/O.

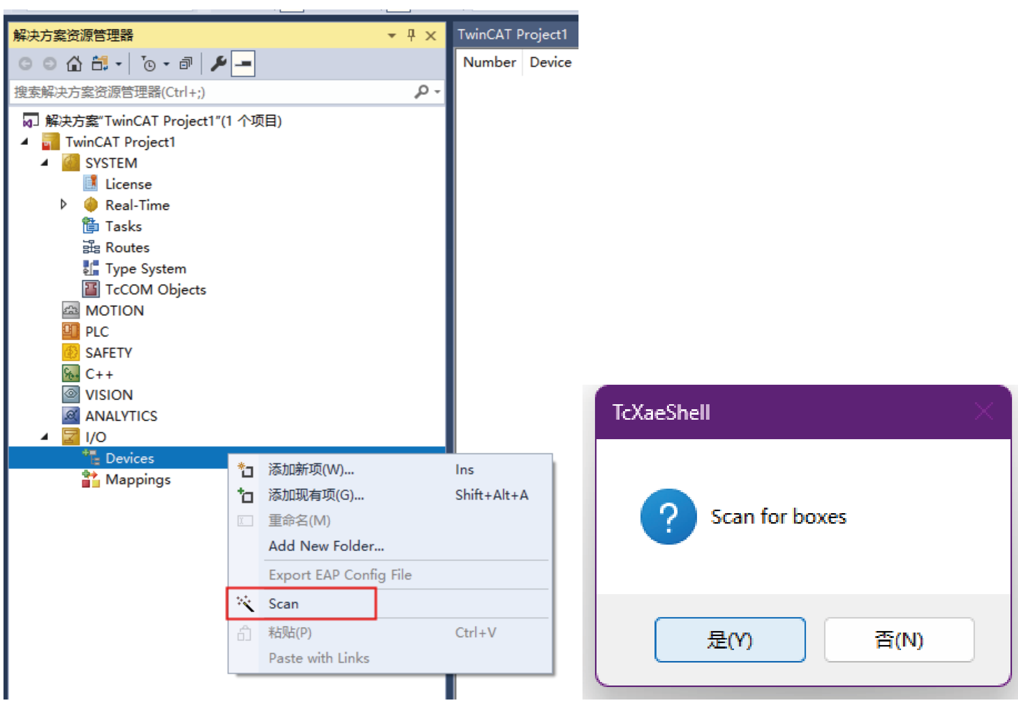
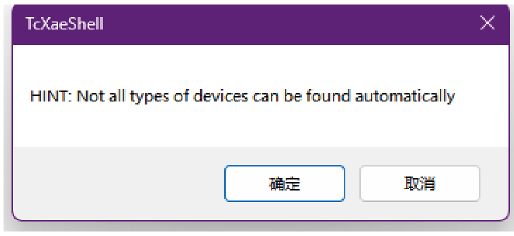
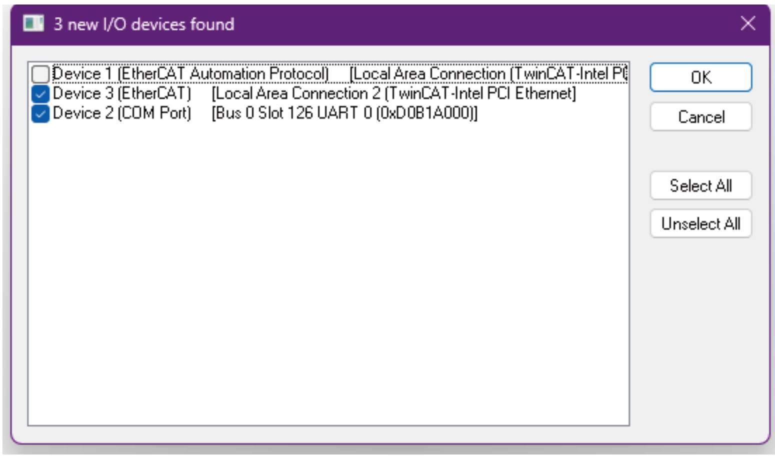


Figure 12-36 Scanning the drive

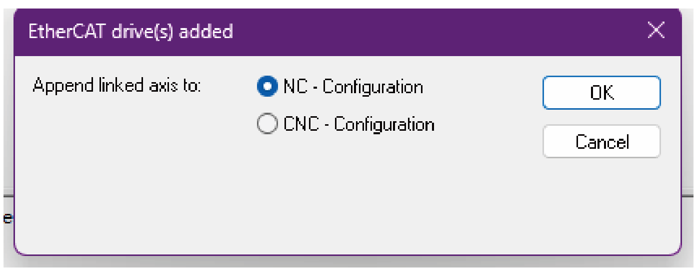
A dialog box will appear indicating that not all device types can be scanned automatically. Click "OK".



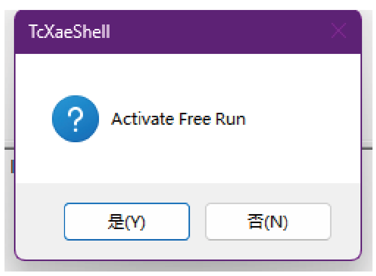
After scanning the EtherCAT bus, click "OK".



When motion control devices are scanned, the system will ask whether to link the scanned axes to the NC configuration. Click "OK" to complete the mapping.



Click "Yes" to activate Freerun debug mode. In debug mode, users can test I/O without a program.



After completing the above operations, you can see that the 730W drive has been successfully scanned under the left tree menu "I/O" → "Devices".

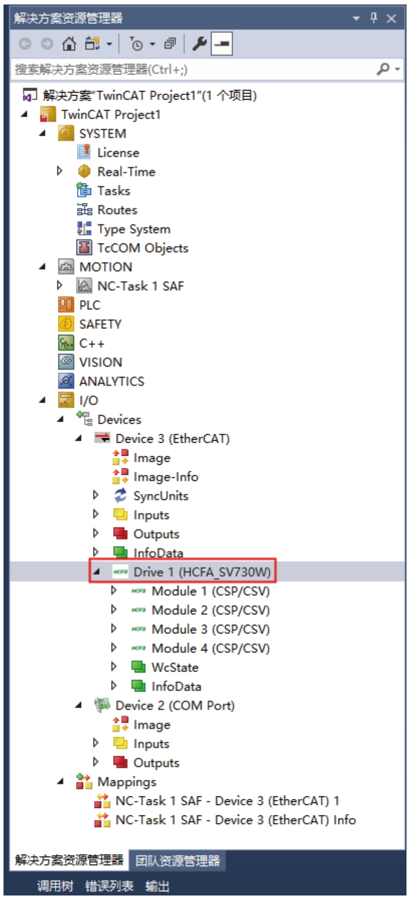


Figure 12-37 Scan completed

12.3.2 Setting EtherCAT related parameters

1. Modify the drive to operate in DC mode. If DC is the default setting, no modification is required. Make the changes sequentially.

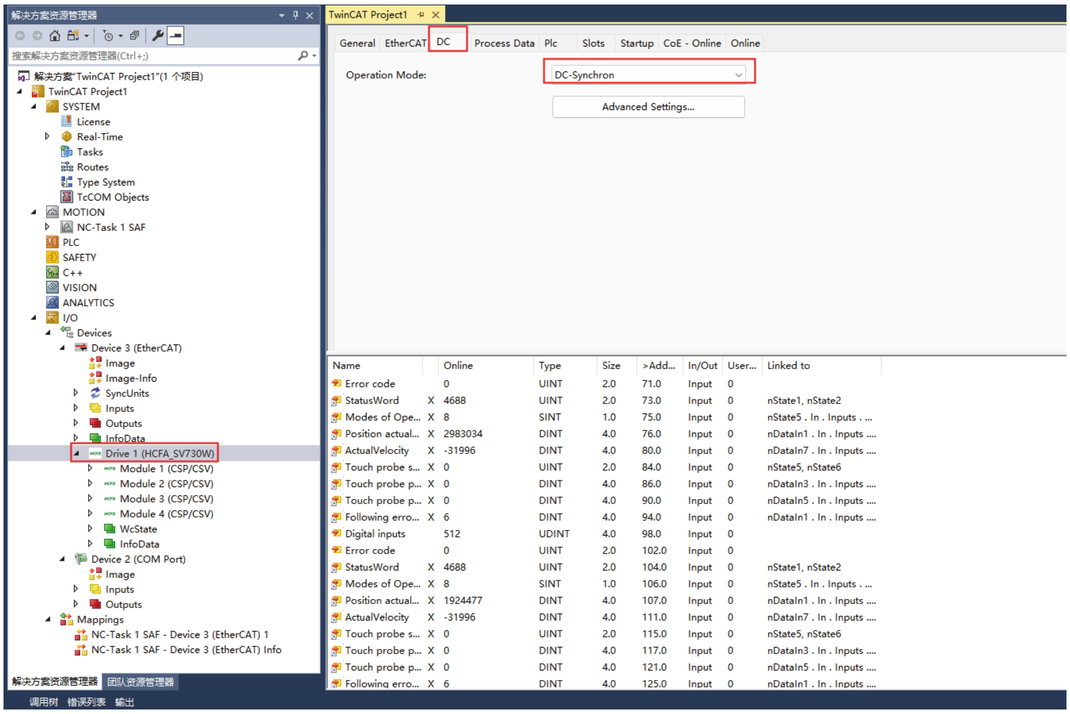


Figure 12-38 Modifying the operating mode

2. Select the required PDO mapping

Click on the scanned 730W drive and find "Process Data" in the configuration interface.

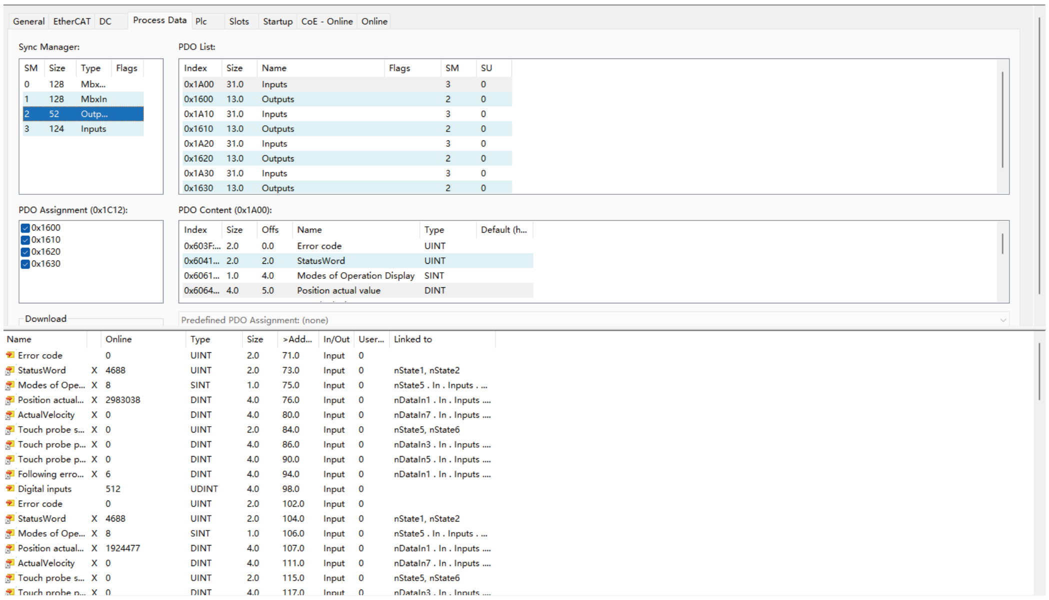
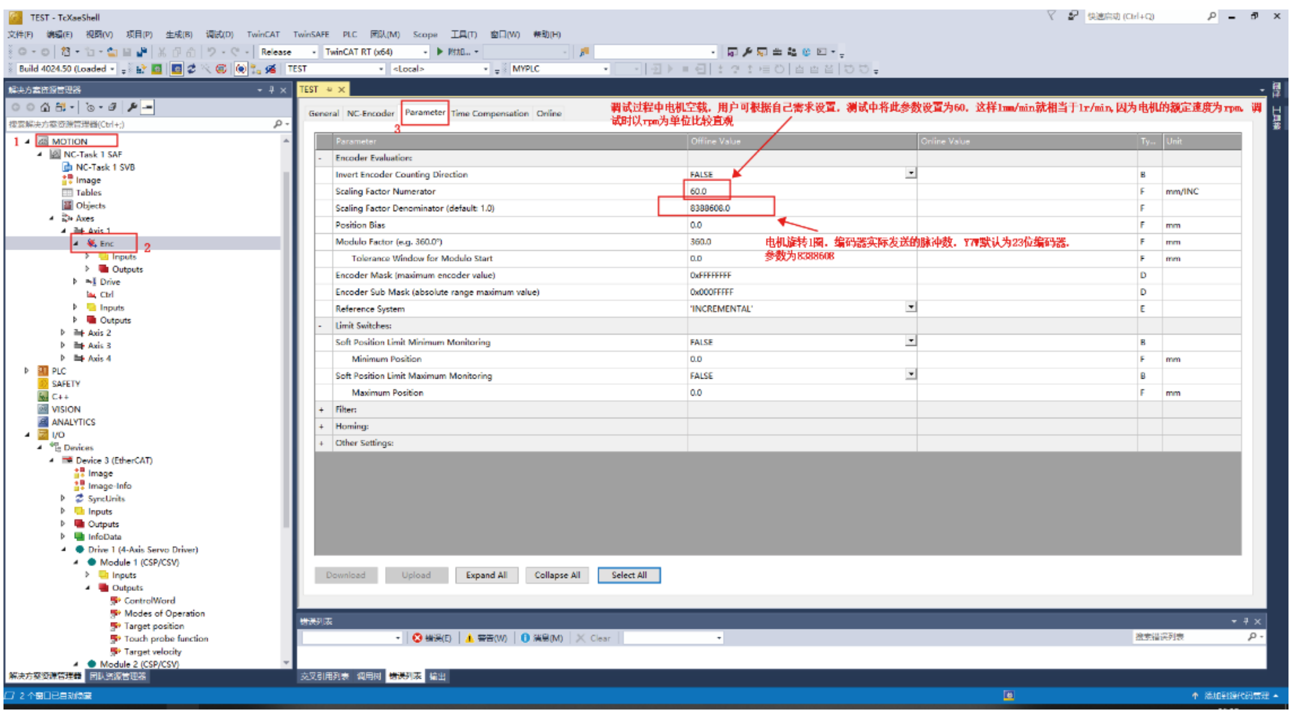


Figure 12-39 Selecting PDO mapping

3. Setting encoder parameters (In this example, the encoder is set for Axis 1. The same procedure applies to other axes.)

Find "Motion" → "Axes" → "Axis1" → "Enc" → "Parameter" in the left tree menu and set the encoder parameters.

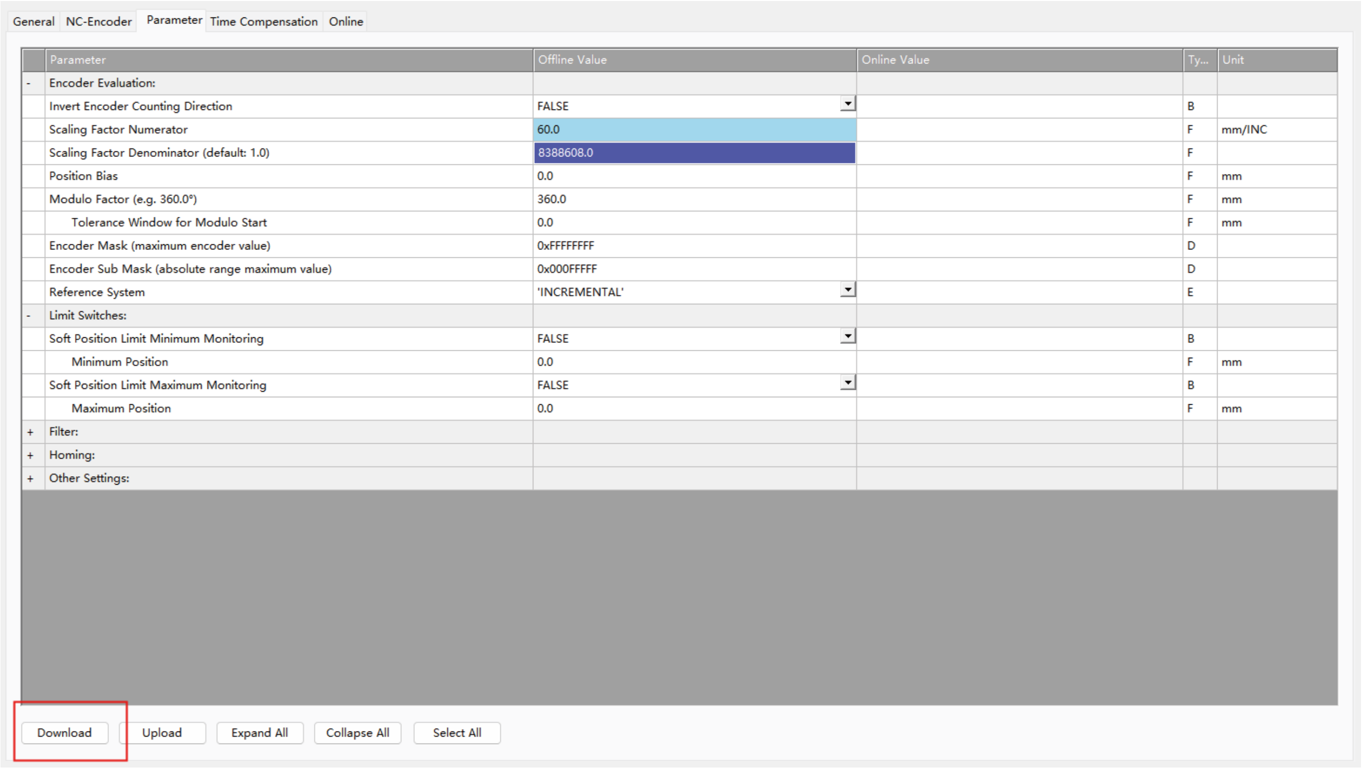


- Scaling Factor: Indicates the distance corresponding to the encoder pulse of each position feedback.

- Scaling Factor Numerator: Represents the displacement of the actuator when the motor rotates one revolution.

- Scaling Factor Denominator: Represents the number of encoder pulses sent when the motor rotates one revolution.

- Encoder Sub Mask (absolute range maximum value): The encoder sub mask is related to the maximum feedback value. For example, for a 16-bit incremental encoder, exceeding 65535 in the forward direction will reset to 0. At this point, the NC will handle the rollover issue, recognizing that the position is steadily increasing rather than experiencing an actual position jump. In this case, the Sub Mask should be set to 0x0000FFFF. It is important to note that many third-party drives (including the 730W) typically set the position feedback increment per motor revolution to 36000. If single-turn reset is also enabled, the Sub Mask should be set to 35999; otherwise, the NC may miscalculate the cumulative position.



A dialog box will appear indicating that the parameter download is temporary and the data will still be lost after restart. Click "OK" to confirm, and then you can see that the offline values will be written into the online values.

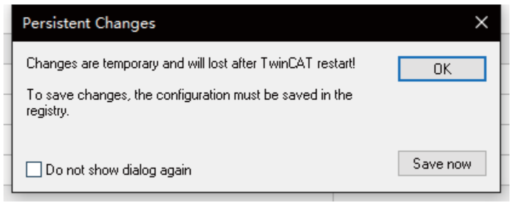


Figure 12-40 Parameter download

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